AD-A116 898   COMMAND AND CONTROL TECHNICAL CENTER WASHINGTON DC   F/G 17/2

GENERALIZED MONITORING FACILITY. USERS MANUAL.(U)

MAY 82   B WALLACK, G H GERO

UNCLASSIFIED   CSM-UM-246-82   NL

1 OF 6

AD A 116898

12

WWMCCS

AD A116898

WORLDWIDE MILITARY COMMAND AND CONTROL SYSTEM

STANDARD SYSTEM SOFTWARE

DEFENSE COMMUNICATIONS AGENCY

COMPUTER SYSTEM MANUAL
CSM UM 246-82
1 MAY 1982

COMMAND & CONTROL TECHNICAL CENTER

GENERALIZED MONITORING FACILITY

USERS MANUAL

RECORD OF CHANGES

CHANGE NUMBER	DATED	DATE ENTERED	SIGNATURE OF PERSON MAKING CHANGE

COMMAND AND CONTROL TECHNICAL CENTER

Computer System Manual CSM UM 246-82

1 May 1982

GENERALIZED MONITORING FACILITY

Users Manual

SUBMITTED BY:

Barry M Wallack
George H. Gero

BARRY M. WALLACK
GEORGE H. GERO, JR.
Project Officers

APPROVED BY:

for Ernest L Smith

ALAN GROSS
Colonel, USAF
Deputy Director for
Computer Services

Copies of this document may be obtained from the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314

Approved for public release; distribution unlimited.

ACKNOWLEDGMENT

This manual was prepared for the Computer Services Directorate of the Command and Control Technical Center (CCTC) under the direction of the Computer Performance Evaluation Office (C751).

CONTENTS

Section		Page

Section		Page

Section		Page

Section		Page

Section | Page

Section		Page

Section		Page

Section		Page

Section		Page

ILLUSTRATIONS

Section		Page

Section		Page
7-25	Specific Device Area Report Card Input	7-48
7-26	Limited File Code Summary Input Card Format	7-51
7-27	Input Option TIME Card Format	7-53
7-28	MSMDRP JCL	7-55
8-1	IOM Configuration	8-2
8-2	System Configuration and Channel Usage Report	8-9
8-3	System Summary Report	8-11
8-4	System Traces Captured by Monitor Report	8-14
8-5	Channel Status Changes Report	8-15
8-6	Physical Device, Device ID Correlation Table	8-16
8-7	Channel Busy and Device Busy Report	8-17
8-8	Channel Busy and Device Free Report	8-18
8-9	Channel Free and Device Busy Report	8-19
8-10	Channel Free and Device Free Report	8-21
8-11	GEPR Connect Report	8-22
8-12	Lost Interrupt Report	8-23
8-13	Device ID STIOS Not Connected	8-24
8-14	Entries Still in Queue	8-25
8-15	Idle Report	8-26
8-16	Proportionate Device Utilization Report	8-28
8-17	Device Queue Length and Time Histograms	8-30
8-18	Channel Queue Length and Queue Time Report	8-32
8-19	I/O Service Time Report	8-35
8-20	Activity Statistic Report	8-38
8-21	Job Conflict Report	8-40
8-22	Special Job Processing Report by Device	8-42
8-23	Special Job Processing Report Per 5 Minute Report . . .	8-43
8-24	Input Option TIME Format	8-48
8-25	CMDRP JCL	8-50
9-1	Communications Analysis Concept	9-3
9-2	CAMDRP Header Page	9-5
9-3	Mailbox Report	9-6
9-4	DAC Device Summary Report	9-12
9-5	DAC Subsystem Summary Report	9-14
9-6	Remote Batch Device Summary Report	9-15
9-7	Terminal ID Summary Report	9-17
9-8	Delta Time Period Summary Report	9-19
9-9	Machine Response Time Report	9-21
9-10	User Think Time Report	9-22
9-11	Session Length Report	9-23
9-12	Response Time/User Think Time Limit Report	9-25
9-13	Terminal Session Report	9-26
9-14	High Terminal Usage Report	9-27
9-15	Opcode Count Report	9-28
9-16	Response Time Report	9-30
9-17	Card Format - Input Option TIME	9-32
9-18	Histogram Reports, Input Option HISTG	9-35
9-19	Terminal Mailbox Dump, Input Option MAIL	9-37

Section		Page

Section		Page

TABLES

ABSTRACT

This Users Manual provides the information necessary for an individual to run all of the programs that are comprised in the Generalized Monitoring Facility (GMF). Program interrelationships are presented, as well as a general overview of the processing, input, and output procedures for each program. Formats and examples of user-controlled input data and sample program outputs are shown and explained. Additionally, the Job Control Language (JCL) deck setups necessary to run the programs are provided.

This manual supersedes Command and Control Technical Center CSM UM 246-81, 1 May 1981.

SECTION 1. GENERAL

1.1 Purpose of the Users Manual

The Users Manual describes each of the programs in the Generalized Monitoring Facility (GMF), discusses input options required to run each program, and provides sample outputs generated by each program.

The Generalized Monitoring Facility is delivered on a FILSYS SAVE tape. A description of the software is presented in section 2. Installation procedures for the GMF Monitor and guidance on how to run GMF can be found in section 5 of this manual.

1.2 Project References

The Generalized Monitoring Facility was originally developed for the Government by Honeywell Information Systems. Since delivery of the completed software in 1975, the Computer Performance Evaluation Branch (C751) of the Command and Control Technical Center has extensively modified and rewritten the GMF system. Numerous software errors have been corrected and many new features have been added.

1.3 Terms and Abbreviations

The following abbreviations will be used throughout the document.

CAM	-	Communications Analysis Monitor
CM	-	Channel Monitor
CPU	-	Central Processing Unit
CPUM	-	CPU Monitor
GCOS	-	Generalized Comprehensive Operating System
GMC	-	Generalized Monitoring Collector
GMF	-	Generalized Monitoring Facility
GRTS	-	General Remote Terminal Supervisor
GRTM	-	GRTS Monitor
IDLEM	-	Idle Monitor

MSM	-	Mass Storage Monitor
MUM	-	Memory Utilization Monitor
RMC	-	Resource Monitor Collector
RMDRx	-	Resource Monitor Data Reduction Program 1 through 3
RMON	-	Resource Monitor
TM	-	Tape Monitor
TPEM	-	Transaction Processing Executive Monitor
WWMCCS	-	World Wide Military Command and Control System

1.4 Security and Privacy

There are no classified data collected in the GMF, but there is one exception. If the Communications Analysis Monitor (CAM) is being run with the Specific Terminal Option, classified data may be collected.

1.5 Manual Format

Section 2 of this Manual provides an overview of the GMF system. A brief description of each program is included. Sections 3 through 12 describe the programs of the GMF system in detail. In the presentation the user will find the appropriate information to successfully operate each program. The format of the sections includes a discussion of each program in the input, processing, and output phases. Section 13 of the document describes the procedures that a user should follow if it is desired to create a new GMF monitor and section 14 provides detailed information as to how GMF should be used in conducting a complete system-wide evaluation.

SECTION 2. SYSTEM SUMMARY

2.1 System Application

This section explains the GMF system by logically grouping the programs into two subsystems, the General Monitor Collector (GMC) subsystem and the Resource Monitor Collector (RMC) subsystem. Overviews of the programs in both subsystems are provided. The purpose of the GMC subsystem is to provide a means of collecting detailed information on the operation of the operating system and on the flow of a job through the system. The purpose of the RMC subsystem is to provide a general view of the operation of the system. The RMC can be run on a daily basis to allow the continuous analysis of the system operation. When it appears a problem is occurring, the GMC can be run to further define and resolve the problem area.

2.2 System Operation

Both GMC and RMC monitor GCOS in real time and generate output tapes. These output tapes are then processed through a series of data reduction routines which produce histograms, graphs, and reports which allow an analyst to evaluate system performance. Both RMC and GMC have exclusive data reduction routines (i.e., a tape generated by RMC cannot be reduced by the GMC data reduction program). Differences between the GMC and RMC subsystems pertain to the methods used to collect measurement data.

The RMC is a sampling-based monitor. At 30-second intervals, the RMC enters execution and collects its data. Since it samples only at preselected intervals, it cannot present a complete history of what has occurred on the system. However, because the RMC is a sampling-based monitor, overhead is low.

The GMC is a trace-based monitor. The various monitors that are comprised in the GMC subsystem are called into execution by the occurrences of the events that are to be captured. The GMC can therefore be used to provide a complete and detailed history of system performances.

Because all occurrences of a given event are retrieved, GMC overhead is higher than RMC. Unlike the RMC, GMC must be locked into core.

2.2.1 <u>The Resource Monitor Collection (RMC) Subsystem.</u> The RMC subsystem is composed of a data collector, RMC, and three associated data reduction routines. The RMC is explained in section 3, and the RMC data reduction routines are discussed in section 4.

The RMC is a sampling-based monitor. The RMC will sample system queues and tables on a 30-second time interval. The data captured from these queues and cells are written to the system accounting file.

The output generated by the RMC is input to a series of three data reduction routines. Sample report output from these data reduction routines can be found in subsection 4.3. See figure 2-1 for the RMC system flowchart and figure 2-2 for the subroutines that comprise the RMC system.

2.2.2 The Generalized Monitor (GMC) Subsystem. The GMC subsystem is composed of a series of data collector programs and a related set of data reduction programs. Each data collector program consists of one or more subroutines, and each program is used to monitor a different area of system performance. The name of the program indicates the area of system performance measured. In addition, any combination of monitoring programs may be executed during a monitor session. A detailed description of the entire data collector facility is given in section 5. Figure 2-3 shows the interrelation of all programs within the GMC subsystem. Figure 2-4 shows the subroutines that comprise each data collector program and those trace types which need to be active for each subroutine.

The mechanism used by the GMC data collector for obtaining control from the operating system is that of the normal system trace. The trace records a history of the occurrence of one or more of 72 systems events, 65 of which are presently defined. This recording is done by the system executing a unique code set resident in the System Dispatcher Module (.MDISP). Execution of this code is common to all system trace events and provides the point at which the GMC obtains control. See section 5 for a detailed description of how GMC gains control from the system.

The executive routine of the GMC processes input cards for the data collection routines determines which areas of the system are to be monitored, performs any necessary initialization, and controls all data buffering and tape writing. A detailed description of this routine is given in section 5. The associated GMC data reduction programs are described in sections 6 through 12.

2.3 System Configuration

The GMF is designed to be run on a HIS 6000 computer system, running with WWMCCS GCOS release 6.4 or 7.2. These releases are equivalent to the HIS commercial 2H or 4JS (any level) GCOS releases. When GMC is used on WWMCCS release 7.2, or commercial release 4JS (any level), the user must insure that the value for variable "SYS64" is changed from its current value of 1 to a value of 0. See subsection 2.6 for a complete description of all user requirements prior to using the GMC. When RMC is used on WWMCCS release 7.2, or commercial release 4JS (any level), the user must insure that the value for variable "W6.4" is changed from its current value of 1 to a value of 0. See subsection 3.3.1 for details of this requirement.

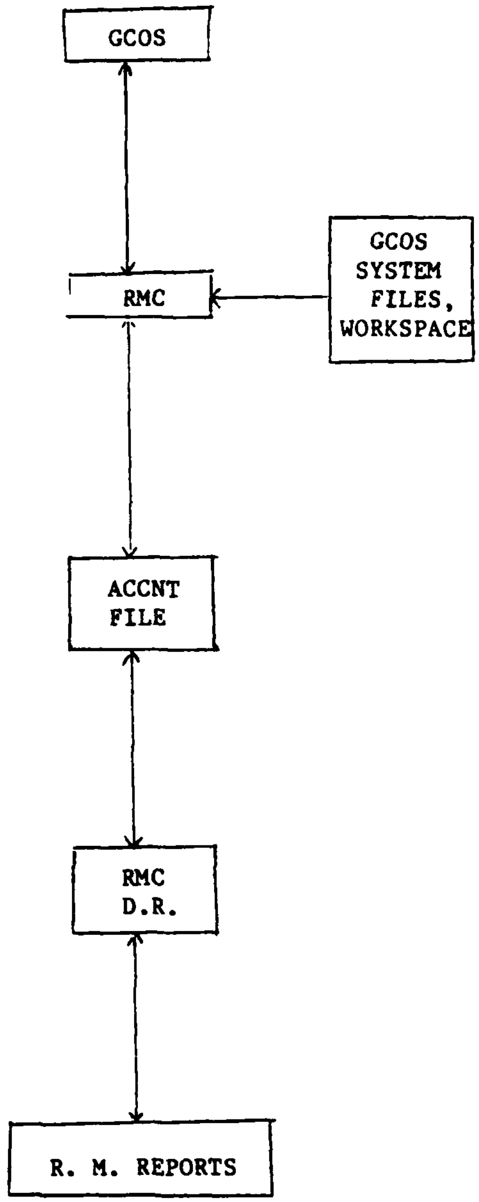


Figure 2-1. RMC Flowchart

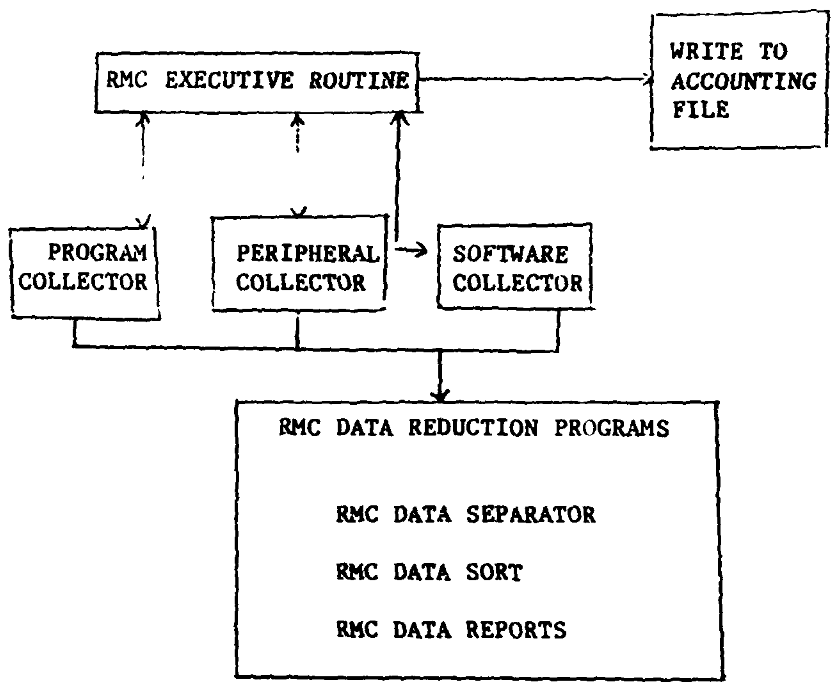


Figure 2-2. Programs in the RMC Subsystem

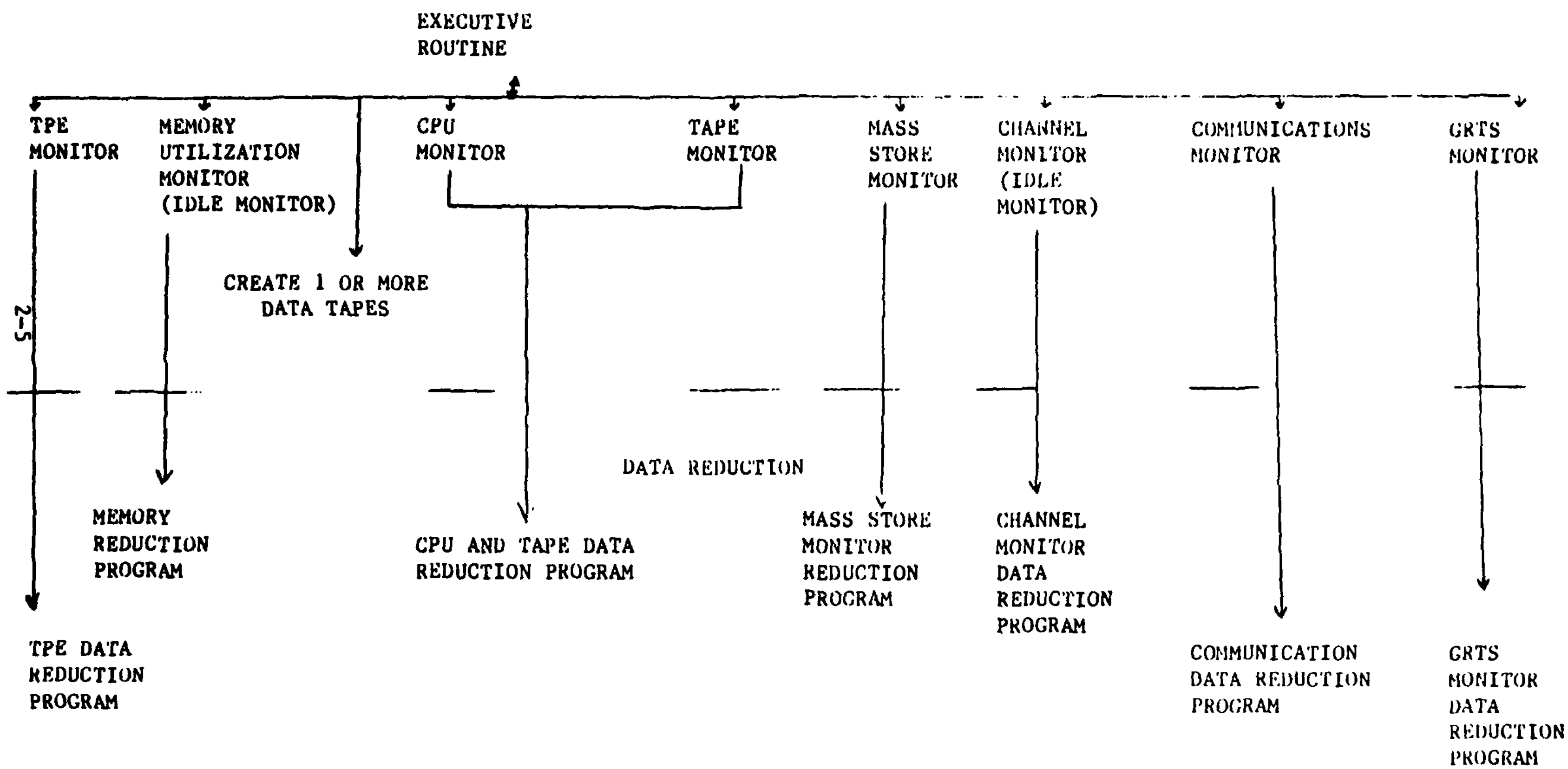


Figure 2-3. Programs in the GMC Subsystem

Data Collector Programs	Subroutines	Traces Captured
Memory Utilization Monitor	T10 T46	10,11,51 46
Idle Monitor	T21 TRCS	21 0,1,2,3,13,16,22, 37,65
Mass Store Monitor	T7	7,15,73*,76*,77*
Channel Monitor	T4,T7,T22	4,7,15,22
Tape Monitor	T50	50,51,52
CPU Monitor	T70	10,11,21,70*
Communications Analysis Monitor	T14	14*
GRTS Monitor	T62	62*
TPE Monitor	T200	0,1,2,4,5,6,13, 42,51,65,74*

- Nonstandard traces generated by the particular monitor.

Figure 2-4. Subroutines and Traces in GMC Data Collector Programs

2.4 System Organization

The GMF is composed of two data collectors, GMC and RMC, and associated data reduction programs. Sections 3 through 12 describe these programs. Figure 2-1 gives a system flowchart for the RMC. Figure 5-1 gives a system flowchart for the GMC.

2.5 Performance

The GMF monitors the performance of a system, aids in identifying the start of system performance problems, and aids in analyzing system performance problems. The RMC requires very little system resource usage and writes all its data to the system accounting file. The GMC is a much more detailed system with the associated higher overhead. The GMC is used mainly to determine the cause of system performance problems. The GMC requires 15 to 24 thousand words of memory and one tape drive while being run. Both systems require offline data reduction.

2.6 GMF Installation

2.6.1 Creation of GMF Files. The GMF software is contained on a single user save tape. The USERID on the tape is B29IDPX0. This USERID must be created with 4200 LLINKS of file space. A user restore can then be run. B29IDPX0 is subdivided into several catalogs described below:

. GMFCOL - 685 LLINKS - This subcatalog contains all the data collection software for the GMC monitoring system. All files within this subcatalog are completely described in section 5.

. SOURCE - 1850 LLINKS - This subcatalog contains Time Sharing source files for all data reduction programs contained within the GMC system. Figure 2-5 is a breakdown of the individual files within this subcatalog. Sections 6-12 describe each program in detail.

. OBJECT - 1010 LLINKS - This subcatalog contains the object decks for all the data reduction programs contained within the GMC system. Figure 2-5 is a breakdown of the individual files within this subcatalog.

. JCL - 18 LLINKS - This subcatalog contains all the JCL required to run all the data reduction programs contained within the GMC system. Figure 2-6 is a breakdown of the individual files within this subcatalog.

. RMON - 345 LLINKS - This subcatalog contains all the software required to collect and reduce the data for the RMON Monitoring system. This subcatalog is further subdivided into JCL, SOURCE and OBJECT subcatalogs. The files within these subcatalogs are completely described in sections 3 and 4.

FILE NAME	FUNCTION	SOURCE SIZE (LL)	OBJECT SIZE (LL)
MUM	MEMORY UTILIZATION MONITOR DATA REDUCTION PRO-. GRAM. REFERENCED IN CHAPTER 6.	355	207
MSM	MASS STORE MONITOR DATA REDUCTION PROGRAM. REFERENCED IN CHAPTER 7.	295	160
CM	CHANNEL MONITOR DATA REDUCTION PROGRAM. REFERENCED IN CHAPTER 8.	250	170
CAM	COMMUNICATION MONITOR DATA REDUCTION PROGRAM. REFERENCED IN CHAPTER 9.	165	85
CPU-TAPE	CPU AND TAPE MONITOR DATA REDUCTION PROGRAMS. REFERENCED IN CHAPTER 11.	389	160
GRT	DATANET 355 MONITOR DATA REDUCTION PROGRAM. REFERENCED IN CHAPTER 10.	280	142
TPETG	TRANSACTION PROCESSING DATA REDUCTION PROGRAM. REFERENCED IN CHAPTER 12.	64	60
TPEALT	AN ALTER FILE FOR ADDING TPE TRACE CODE INTO THE TPE SUBSYSTEM (NO OBJECT FILE). REFERENCED IN CHAPTER 12.	14	
TPEDUMP	A PROGRAM FOR OBTRAINING A FORMATTED TRACE DUMP FROM A TPE/GMF DATA TAPE. REFERENCED IN CHAPTER 12.	38	26

Figure 2-5. B29IDPX0/SOURCE and B29IDPX0/OBJECT Catalog Structure

FILE NAME	FUNCTION	SOURCE SIZE (LL)
MUM	JCL TO OBTAIN ALL MEMORY UTILIZATION MONITOR REPORTS	2
MSM	JCL TO OBTAIN MASS STORE MONITOR REPORTS	2
CM	JCL TO OBTAIN CHANNEL MONITOR REPORTS	
CAM	JCL TO OBTAIN COMMUNI-CATION MONITOR REPORTS	2
GRT	JCL TO OBTAIN DN-355 MONITOR REPORTS	2
CPU	JCL TO OBTAIN CPU MONITOR REPORTS	2
TAPE	JCL TO OBTAIN TAPE MONITOR REPORTS	2
TPETG	JCL TO OBTAIN ALL REPORTS FROM THE TPE DATA REDUCTION PROGRAM	2
TPEDUMP	JCL TO OBTAIN ALL REPORTS FROM THE TPE FORMATTED TRACE DUMP PROGRAM	14

Figure 2-6. B29IDPXO/JCL Catalog Structure

2.6.2 GMF Release Dependent Parameters. In order for the GMC to operate properly, it is necessary for GMC to locate certain instructions and/or words within several system programs. The user should insure that these locations are correct for the particular GCOS release, under which he is operating. Table 2-1 is a list of these dependent parameters identifying their the use and providing the approximate program source line numbers where the particular parameters are used. The list is provided for each GMC program that must checked by the user.

In order to use the GMC data reduction programs on a WW6.4 system, there is a special data card required in certain programs. This option applies to all data reduction programs except CPU-TAPE and TPETG. The TPETG program is not designed for use under any release other than WW7.2. The CPU-TAPE program would require a one-line source change to be used under a WW6.4 release.

The GMC system is designed so that data collected on a WW6.4 system may be reduced under a WW6.4 system or a WW7.2 system. In addition, data collected under a WW7.2 system may likewise be reduced under a WW7.2 system, or a WW6.4 system. Whenever the data reduction programs for MUM, CM, CAM, or GRT are used on a WW6.4 system, a data card with an RN typed on it must be included in the input section of the JCL deck. It makes no difference under what release the data was collected. It is only a question of under what release the data is being reduced.

For the MSM data reduction program, there are two data cards required. The first data card always contains the letters RN. The second card is determined by the following table:

Data Collected	Data Reduced	Data Value
WW6.4	WW6.4	1
WW6.4	WW7.2	3
WW7.2	WW6.4	2
WW7.2	WW7.2	NO SPECIAL CARDS REQUIRED

For the CPU-TAPE data reduction program, it is required to delete source line #4320 and recompile when using the data reduction program under a WW6.4 release.

The RMC System is also designed to run under GCOS release WW6.4.2 (commerical release 2H), or WW7.2 (commercial release 4JS (any level)). See subsection 3.3.1 for details as to required modifications.

Table 2-1. GMC Release Dependent Parameters

Program	LINE #	Variable	Explanation
GMF.TOP	90	SYS64	Used to control conditional assembly of GMC set=1 for W6.4(2H) release set=0 for W7.2(4J) release
	10220	-	Code in this area searches for trace processing within the dispatcher. Trace code must be within 500 octal locations of the address specified by entry pt 15 decimal of the dispatcher. The code being searched for is a LDAQ;STAQ;TRAO,1
	10700	-	Code in this area is used to make a correction to accounting processing, if the correction has not already been made via patches. The code is searched for within 500 octal locations of .MIOS entry point. The code searched for is SBLA TRREG+7,$;ARL 12; ADLA .CRTOD,7. The ARL is changed to an ARS.
CPU.PAT	10 210 230 420 720 740 1460 1480 1190	-	Code in this area searches for an ASA .SALT,5 Instruction in the dispatcher. In W6.4 search octal locations 1500-1700. In W7.2 search octal locations 2340-2450. In addition in W7.2 we need to find a STQ .QTOD,4 instruction between octal locations 2400-2460. For both releases we need to find 8 words of patch space. In W6.4 between octal locations 3540-3740. In W7.2 between octal locations 4600-5000. If not found here then search octal locations 4150-4300 in W6.4 or octal locations 5400-5530 in W7.2. In addition .MFALT is searched in W7.2 for an ARL 12 instruction between octal locations 2500-2550. This is for gate locked timing code which is supposed to be assembled into W7.2 code.

Program	LINE #	Variable	Explanation
CAM.PAT	10 140 370 720 740	-	Code in this area searches for a LDQ M.LID,3 instruction in DNWW, followed by a ANQ=0077777,DU instruction. Octal locations 5000-6000 are searched. Ten words of patch space must be obtained. This patch space must be between octal locations 11020 and 11160. If patch space is not found then 7 words of patch space are searched for within the dispatcher. This search is performed between octal locations 3540-3740 in W6.4 and octal locations 4600-5000 in W7.2. It should be noted that in commercial releases and WW7.2, DNWW is referred to as DNET.
MSM.PAT	10 390-680 850 870 1320 1340	-	Code in this area searches for an AOS .CRTDL instruction and an AOS .CRTBH instruction in the dispatcher. In W6.4 and W7.2, these need to be within 300 octal locations of the label DBASE. If these instructions are not found, a search is made from octal locations 4600-5100 in W6.4 and octal locations 7164-7464 in W7.2. In addition, 8 words of patch space is needed. In W6.4 between octal 3540-3740. In W7.2, between octal 4600-5000. If the patch space is not found then search between octal locations 4150-4300 in W6.4, or octal 5400-5530 in W7.2. In addition in W7.2 FMS CACHE logic is also analyzed. See label TSFIO in routine T7 for locations required within FSIO module.
GMF.MON	840	FMS1	Offset from entry point of .MFSIO which points to the word giving the absolute address of FMS catalog cache buffer. Used only in W7.2. Set to -13 decimal.
	850	FMS2	Offset from entry point of .MFSIO pointing to the work which gives the option selection for FMS catalog cache. Used only in W7.2. Set to -15 decimal.

Program	LINE #	Variable	Explanation
MUM.T10	220	SYS64	See GMF.TOP
	920	FIFO	Address of the FIFO buffer within PALC. It is used to search the JCT table of PALC. It is set to 113 octal. This includes adding in a 110 octal offset for the loading of PALC in W6.4. There is no PALC offset in W7.2.
	5280	XPQ24	Location in CALC of the memory demand table. Set to octal 111.
	5290	SLVSNB	Offset in slave prefix area of job SNUMB. Set to octal 36.
	5300	MEMUSE	Offset in slave prefix area of loader memory use word. Set to octal 37.
	5310	IDENT	Offset in slave prefix area of job IDENT. Set to octal 66.
CPU.T70	120	SYS64	See GMF.TOP
CM.T07A	180	IDENT	Offset in slave prefix area of job ident. Set to octal 66.
	200	SYS64	See GMF.TOP
	8990	.	This area of code searches .MFSIO in W7.2 to gather statistics for FMS catalog cache processing. Code should be checked to assure correct addresses are checked.
	10340	FFCCC	Address in PALC where the file code is stored during GEFSYE processing. Set to 6177 octal in W6.4 and 13143 octal in W7.2. This includes 110 octal for loading of PALC in W6.4.
	10350	SNUMBP	Address in PALC where the SNUMB is stored during GEFSYE processing. Set to 35012 octal in W6.4 and 2632 octal W7.2. This includes 110 octal for loading of PALC in W6.4
	10360	ACT	Address in PALC where the activity number is stored during GEFSYE processing. Set to 33231 octal in W6.4 and 1051 octal in W7.2. This includes 110 octal for loading of PALC in W6.4. There is no offset for PALC in W7.2.

This page intentionally left blank

SECTION 3. RESOURCE MONITOR COLLECTOR

3.1 Introduction

The RMC is a privileged software package which periodically samples the system programs, queues, counters, and tables of GCOS. The RMC consists of initialization routines, general purpose routines, and three discrete data collector routines, named:

- Program collector
- Peripheral collector
- Software collector

Each of the data collectors generates a unique record format in one of the common buffer areas. A .CALL to .MSCF,2 is made to write each record to the system accounting file.

3.2 RMC Input Options and JCL

There are currently no RMC user input options. The JCL needed to execute the RMC is shown in figure 3-1. Since the RMC runs in master mode, it requires a $ PRIVITY card, meaning the operator must GRANT the job. The RMC requires a SNUMB of RMON to run. The program checks to insure this SNUMB is present or else it will abort with a R1 abort.

3.3 Processing

The RMC requires no special tapes or disk files. All data is written to the Statistical Collection File (SCF). The RMC will swap out of core if required and produce low system overhead. The next subsections discuss the collection routine of the RMC and give the record formats.

3.3.1 Collection Routine. The RMC collection routine is a GMAP program requiring PRIVITY. As currently released, the program uses SCF record number 609 for its data record. The user may alter the source file to collect other than 609 record data. The procedure is to alter line 230 in B29IDPX0/RMON/SOURCE/64COL to read . . . EQU NNN, where NNN is a new record number. The same change must be done at line 140 in file B29IDPX0/RMON/SOURCE/RMDR1. RMC is designed to run under GCOS release WW6.4.2 (commercial release 2H), or WW7.2 (commercial release 4J (any level)). To collect data for system release W7.2 (commercial release 4J (any level)) source line 220 in 64COL must be altered to EQU 0, as well as source line 130 in RMDR1. If RMC is to be run on a commercial system, additional changes must be made. In B29IDPX0/RMON/64COL, code located at TSS line numbers 641-649, and 5761-5764 should be compiled (delete * from beginning of line). In the same file, lines 2440, 2460 and 2480 should be deleted. Lines 2441, 2461 and 2481 should be compiled (* deleted).

```
$      SNUMB      RMON
$      IDENT
$      USERID
$      OPTION     NOSETU
$      LOWLOAD    LSW
$      NOLIB
$      SELECT     B29IDPXO/RMON/OBJECT/64COL
$      EXECUTE    DUMP
$      LIMITS     999,4K,,500
$      PRIVITY
$      ENDJOB
```

Figure 3-1. RMC JCL

The RMC writes three type 609 records every 30 seconds. The type 609 record consists of one of three subtypes. These subtypes are a maximum of 210 words with the maximum size dependent upon the configured system size. The RMC initially insures that its SNUMB is RMON. This insures only one copy of RMON is running at any time. The RMC then initializes its tables according to the system configuration. Extended memory instructions are NOPed if required and any excess memory is released. The RMC then processes each of its record types every 30 seconds.

The following procedure applies to the WWMCCS software releases. The user should insure that the 600 class of SCF records have been turned on for his system. He must check two different places. First, the $SCFBUF card in the boot deck must contain at least a C6 to indicate collection of 600 level SCF records. The user should then enter the command SCFRST 609 at the system console. The system should respond with: 609/AC to indicate that the records are being collected.

The user must next insure that the system MASK cards are defined correctly. The 600 class SCF records must be turned on in INIT by use of a MASK card in the boot deck. The location to be patched with the MASK card is RMAX+6 in INIT. The location should be patched with the following octal patch

COL 1	8	13	73
OCTAL LOCATION OF RMAX+6	MASK	000012000000	.MINIT

This patch allows 10 type 600 SCF records to be collected (600-609). These same procedures should be followed by the user if he also changes the RMON SCF record number. Commercial 4Jx sites should check the System Startup Manual for procedures on defining new SCF record types.

3.3.1.1 Program Data - Subtype 1. This data type contains overhead and idle times for all configured processors, size of memory, number of processors, and number of TSS users. Each job in the system is examined and its status is saved. The subtype 1 record format is:

WORD	BITS	CONTENT
1	0-17	Size (210 words max)
	18-35	record type
2-13	0-35	Standard SCF header
14	0-17	Zero
	18-35	1 (subtype)
15	0-17	Number of TSS users
	18-35	Available memory

16-18	0-35	Not Used
19	0-35	Overhead time (.CROVH)
20	0-35	Idle time (.CRIDT)
21	0-17	Number of processors
	18-35	Configured memory (.CRMSZ)
22	0-29	SNUMB
	30-35	Reserved
23	0-17	Status from .CRSN1
	18-35	Memory size if in memory
24	0-35	Accumulated processor time

22-24 are repeated for all jobs in the system.

3.3.1.2 Peripheral Data - Subtype 2. This data type consists of channel use time for each channel, device status (released, assigned, dedicated, permanent, removable), and capacity of disk packs. The subtype 2 record format is:

WORD	BITS	CONTENT
1	0-17	Size (210 words max)
	18-35	Record
2-13	0-35	Standard SCF header
14	0-17	Zero
	18-35	2 (subtype)
15	0-17	Number of IOMs
	18-35	Available links of mass storage
16-18	0-35	Not used
19	0-5	Translated device code
	6-11	Reserved
	12-17	Number free devices
	18-23	Number allocated devices
	24-29	Number dedicated devices
	30-35	Number released devices
20	12-35	Offset for channel/device status counts
21	0-35	Channel use time

Words 19 and 21 are repeated for each channel.

3.3.1.3 Software Data - Subtype 3. This data type consists of system scheduler data, number of jobs swapped, number of jobs moved, number of memory compactions, and number of activities. The subtype 3 record format is:

WORD	BITS	CONTENT
1	0-17	Size (81 words max)
	18-35	Record size
2-13	0-35	Standard SCF header
14	0-17	Zero
	18-35	3 (subtype)
15	0-17	Flag, 0 if scheduler swapped
	18-35	Reserved
16-18	0-35	Reserved
19-70	0-35	Scheduler class data
71	0-35	Number of activities
72	0-35	Number of connects
73	0-35	Number of dispatches
74	0-35	Number of interrupts
75	0-35	Number of new jobs
76	0-35	Number of jobs moved
77	0-35	Number of jobs swapped
78	0-35	Number of memory compacts
79	0-35	Number of remote jobs
80	0-35	Number of swaps
81	0-35	Number of times processor went idle

3.4 Outputs

The RMC writes all its output to the SCF.

3.5 Abort Codes

The RMC can abort with one of the following aborts:

R1	Snumb not RMON
R2	RMON not lowloaded
R3	Internal Peripheral Table Overflowed (call CCTC, C751)

SECTION 4. RESOURCE MONITOR DATA REDUCTION

The Resource Monitor Data Reduction (RMDR) is composed of three discrete programs. The first program (RMDR1) processes the raw SCF tape to gather the RMC records. The next program (RMDR2) processes the RMC records, sorts, and reformats them. The last program (RMDR3) prints out the required plots. Figure 4-1 is an overview of the RMDR.

4.1 RMDR1

RMDR1 reads the raw SCF data, selects out the RMC data, analyzes it, prints results, sorts it, and passes it to the RMDR2.

4.1.1 RMDR1 Inputs. The RMDR1 program requires one input (SCF data) and has one optional input (System SNUMB list).

4.1.1.1 RMDR1 - SCF Data (File RM). This input is the raw accounting data containing the Resource Monitor data.

4.1.1.2 RMDR1 - System SNUMB (File MF). The RMDR1 contains an internal System SNUMB list. This list is a collection of all SNUMBs in the system that are to be considered as system jobs. Figure 4-2 shows these SNUMBs. An option exists to add up to 12 additional SNUMBs to this list. The user can replace the $ FILE MF,NULL card in the RMDR1 JCL with a $DATA MF card and then add a data card. The data card contains six character SNUMBs (left justified) of the jobs to be added to the system job list. Six blanks will terminate the scan of the data card.

4.1.2 RMDR1 Output. Three outputs are available from RMDR1: (1) formatted dump of RMON data sorted by day (File DF), (2) System SNUMB List (File MF), (3) sorted Resource Monitor data by day and time of day (File AF). When the end of file is encountered on the SCF tape, RMDR1 will ask the operator:

ARE THERE ANYMORE TAPES FOR XXXXX (Y=YES, EOM=NO).

If the operator responds Y or YES, RMDR1 will then tell the operator:

PLEASE MOUNT THE NEXT TAPE FOR XXXXX ON YYYYYY

wherein XXXXX is the RMDR1 SNUMB and YYYYYY is the data tape drive ID. This option allows the user to process multiple tapes in one run. This situation can occur if there were several SCFCLO commands done during a day, or if a week's worth of daily tapes are to be read.

4.1.2.1 RMDR1 - Formatted Dump (File DF). A format dump of all the resource monitor (RMON) data (figure 4-3) is output to file code DF sorted by day. File code DF is normally set to null file since the report contains a large amount of data.

4.1.2.2 RMDR1 - System SNUMB List (File RP). A list on file RP of all the default System SNUMBs, and also any additional user generated SNUMBs, is produced (Figure 4-4).

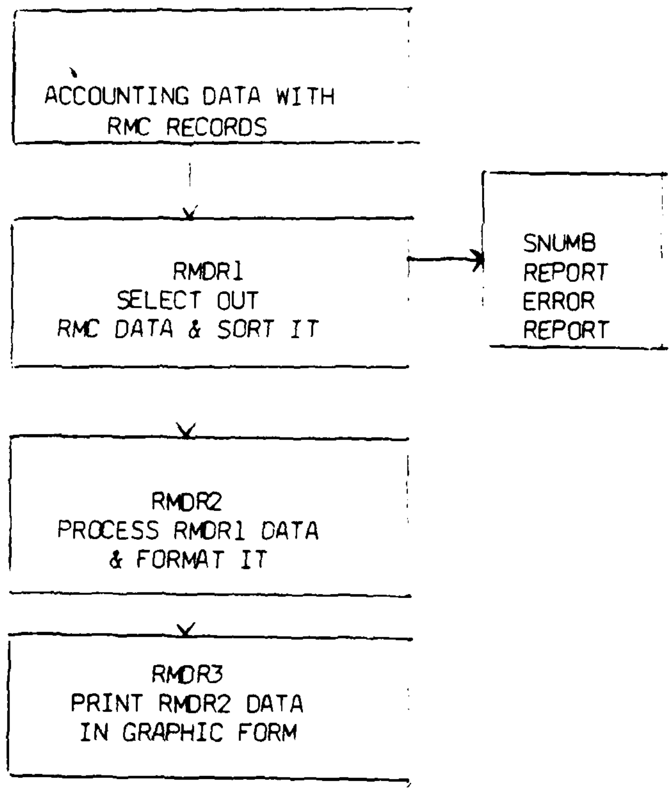


Figure 4-1. RMDR Overview

$CALC	VIDEO
$PALC	$IMCV
$SYOT	$PACT
$RTIN	$TRAX
TSS	$MOLT
$TD/S	$POLT
$FSYS	$COLT
RMON	$TOLT
HEALS	$SOLT
	$SLTA

Figure 4-2. RMDR System SNUMB List

4.1.2.3 RMDR1 - Sorted Resource Monitor Data (File AF). The analyzed Resource Monitor data is sorted by day and time of day and written to file code AF for use by the RMDR2 program. This file may be a tape or a sequential disk file depending upon user space availability.

4.1.3 RMDR1 - Deck Setup. The following control cards are required to execute RMDR1:

```
$       IDENT       ACCOUNTING INFORMATION
$       USERID      USERID$PASSWORD/SCC
$       LOWLOAD     LSW
$       SELECT      B29IDPX0/RMON/OBJECT/RMDR1
$       EXECUTE     DUMP
$       LIMITS      10,30K
$       FILE        S1,S1R,100R
$       FILE        MF,NULL            System SNUMB additions
$       FILE        DF,NULL            Formatted Dump File
$       SYSOUT      RP                 System SNUMB File
$       TAPE        RM,X1D,,XXXXX      Accounting data
$       TAPE        AF,X2D,XXXXX       Sorted RMON data
$       ENDJOB
```

4.2 RMDR2

RMDR2 reads the RMDR1 sorted RMON data from file code AF, reformats that data, processes it, and passes it to the RMDR3 program.

4.2.1 RMDR2 Inputs. The RMDR2 requires two inputs and has a third optional input. The required inputs consist of the formatted data from RMDR1, file code AF, and a configuration card. The optional input is a date card.

4.2.1.1 RMDR2 - Configuration Data Card (File CD). The user defines to RMDR the local site computer hardware configuration in terms of its upper limit capabilities. The user must consult the site computer system boot deck to learn the specific definition and structure of the system. These values will be entered into the CONFIG data card described below.

The RMDR2 and RMDR3 programs are then informed of the system capacity and the nature of the collected data on the SCF input tape. The configuration data is contained in local configuration management documents and from $FILSYS SPUTIL options.

The user should complete this parameter card before preparing the rest of the RMDR2 JCL and any of the RMDR3 JCL.

An entry must be made for each parameter, even if zero. All entries are of equal importance and accurate limits should be used.

The CONFIG data card is formatted as follows:

```
                                  RESOURCE UTILIZATION REPORT   TTLDAT=790331      ASMDAT=017903          PAGE=000002
                              ....MEMORY USE IN K..... ....PROCESSOR USE IN %...  % CHAN USE   AVAIL .TAPE  USE.. PRINTER USE
SYSTEM  DATE    TIME     CONF MSTR SLAV AVAL  TSS C  MSTR SLAVE AVAIL   TSS   MASS  TAPE   LINKS FR RL DF AL FR RL DF AL TSS
...SCHEDULER... JOBS-MASTER JOBS-SLAVE
EXP HLD OTH CLS WP 4N SW EX W? 4N SW EX

OSCC2  790411 12.4656 512  137   93  225  54 2   0.0   0.0   0.0   0.0   0.0   0.0   9291  0 18  0  0  1  5  0  1  2
  0    0   0   0  0  0 0  9    1  0  0  6
OSCC2  790411 12.4749 512  137   93  225  54 2   2.9   3.0 193.9   0.0   3.5   0.0   9291  0 18  0  0  1  5  0  0  2
  0    0   0   0  0  0 0  9    1  0  0  6
OSCC2  790411 12.4832 512  137   93  225  54 2   3.7   2.9 193.3   0.0   3.1   0.0   9291  0 18  0  0  1  5  0  0  2
  0    0   0   0  0  0 0  9    1  0  0  5
OSCC2  790411 12.4916 512  137  107  208  54 2  15.3   3.9 179.0   2.8  25.1   0.0   9289  0 18  0  0  1  5  0  0  4
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.4999 512  217  107  188  74 2   8.3   2.6 189.1   3.8  11.8   0.0   9288  0 18  0  0  1  5  0  0  4
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.5083 512  217  147  148  74 2   7.0   3.0 189.6   2.9  15.8   0.0   9256  0 18  0  0  1  5  0  0  3
  0    0   0   0  0  0 0  9    0  0  0  8
OSCC2  790411 12.5156 512  217  107  188  74 2  83.4   2.2 139.2  65.9  58.7   0.0   9256  3 15  0  0  1  5  0  0  3
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.5249 512  217  107  188  74 2  18.8   4.1 181.2  12.2  15.2   0.0   9256  4 15  0  0  1  5  0  1  3
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.5333 512  217  107  188  74 2  91.9   4.8 142.2  84.5  37.2   0.0   9106  5 13  0  0  1  5  0  0  3
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.5416 512  217  107  188  74 2 173.5   4.8  99.2 165.1  14.2   0.0   9105  5 15  0  0  1  5  1  0  3
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.5500 512  217  107  188  74 2  92.2   2.3 125.8  83.4  43.5   0.0   9098  5 15  0  0  1  5  0  1  3
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.5583 512  217  107  188  74 2  67.8   7.3 129.2  40.5  52.5   0.0   9098  5 15  0  0  1  5  0  0  3
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.5667 512  217  107  188  74 2   7.5   3.5 188.9   2.8  13.3   0.0   9264  5 13  0  0  1  5  0  0  3
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.5750 512  217  147  148  74 2   9.1   3.0 184.2   3.0  17.7   0.0   9255  5 13  0  0  1  5  1  0  3
  0    0   0   0  0  0 0  9    0  0  0  8
OSCC2  790411 12.5833 512  217  107  188  74 2  85.2   2.2 139.3  72.7  57.5   0.0   9256  5 13  0  0  1  5  0  1  3
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.5917 512  237  135  170  64 2  15.0   3.0 182.4   6.7  27.1   0.0   9251  5 13  0  0  1  5  0  0  3
  0    0   0   0  0  0 0  9    0  0  0  8
OSCC2  790411 12.6000 512  237  107  198  64 2 101.0   2.2 139.1  94.9  43.2   0.0   9105  5 13  0  0  1  5  0  0  3
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.6084 512  237  107  198  64 2 173.0   2.7 102.4 166.2  14.1   0.0   9105  5 13  0  0  0  5  1  1  3
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.6157 512  237  107  198  64 2  93.2   2.5 127.3  75.0  52.3   0.0   9098  5 13  0  0  1  5  0  1  3
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.6251 512  237  107  198  64 2  65.5   3.0 135.0  41.2  53.5   0.0   9098  5 13  0  0  1  5  0  1  3
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.6334 512  237  107  198  64 2   7.7   2.6 189.7   3.5  14.5   0.0   9264  5 13  0  0  1  5  1  0  3
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.6417 512  237  107  198  64 2  10.1   4.6 181.2   2.5  17.8   0.0   9256  5 13  0  0  1  5  0  0  4
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.6501 512  237  107  198  64 2  93.3   6.7 127.8  74.6  59.4   0.0   9255  5 13  0  0  1  5  1  1  4
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.6584 512  237  107  198  64 2  15.5   2.7 184.3   9.4  14.2   0.0   9254  5 13  0  0  1  5  0  1  4
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.6658 512  237  107  198  64 2  95.9   2.4 143.0  91.5  38.2   0.0   9104  5 13  0  0  1  5  0  1  4
  0    0   0   0  0  0 0  9    0  0  0  7
OSCC2  790411 12.6751 512  137  107  208  54 2 162.2   2.5 101.9 150.0  50.2   0.0   9104  5 13  0  0  1  5  0  1  4
  0    0   0   0  0  0 0  9    1  0  0  7
```

Figure 4-3. RMDR1 Formatted Dump

```
DATE  11-13-79

                                        UNCLASSIFIED

                      RESOURCE UTILIZATION REPORT  TTLDAT=790301  ASMDAT=017903  PAGE=000001

     DEFAULT MASTER SNUMB LIST

$CALC $PALC $SYOT $RTIN TSS  $TD/S $FSYS COLCT HEALS VIDEO $IMCV $PACT $TRAX $MOLT $POLT $COLT $TOLT $SOLT $SLTA RMON

     IMAGE OF MASTER FILE CARD IF PRESENT

NEWRM                                          00000080
```


Figure 4-4. RMDR1 Default/User SNUMB List

CONFIG SYSNAM MM P T D AA BB CCC SSS FF LLLLLL NNNNNN RRRRRR

The definition of each item follows:

Card Column	Input Value	Explanation
1-6	CONFIG	Required literal
7	blank	
8-13	SYSNAM	Six character system ID for the system to be analyzed. This may be "ANYSYS" if only one system ID is on tape or to analyze only the first system ID found.
14	blank	
15-16	MM	Number of 64K blocks of memory configured
17	blank	
18	P	Number of processors configured
19	blank	
20	T	Number of physical tape channels configured
21	blank	
22	D	Number of physical disk channels configured
23	blank	
24-25	AA	Number of tape drives configured
26	blank	
27-28	BB	Number of printers configured
29	blank	
30-32	CCC	Maximum number of TSS users allowed (050, 100, 200 valid, 100 recommended)
33	blank	
34-36	SSS	Maximum number of jobs allowed in the system scheduler (050, 100, or 200 valid, 100 recommended)
37	blank	
38-39	FF	Maximum number of jobs allowed to be waiting, swapped, or executing (24, 48, or 96 valid, 96 recommended)
40	blank	
41-46	LLLLLL	Number of links of permanent file space configured
47	blank	
48-53	NNNNNN	Number of links of spare file space configured
54	blank	
55-60	RRRRRR	Number of links of removable file space configured
61-80	blank	

NOTE: LLLLLL, NNNNNN, and RRRRRR are used to determine the scaling factor for the disk links usage report. These figures can be obtained from a $FILSYS SPUTIL option (see FMS Manual DD45 page 10-14.)

All values are right justified, zero filled, and separated by one blank.

4.2.1.2 RMDR2 - Date Data Card (File DT). This data card is optional. If this option is not required, a $ FILE DT,NULL should be placed in the JCL. This card allows a site to specify a particular date to be analyzed. If specified, only data for that date will be processed. If not specified, the first date found will be processed. This option can also be used to specify an analysis of all the days on a tape as a group (i.e., a weekly analysis of data). If a date is specified that is not on the data tape, an error condition will occur and processing will halt.

4.2.1.2.1 Daily Processing. If this option is selected, the data card must be as follows:

DAYDATYYMMDDWWW

Where

DAYDAT	Required literal
YY	Year number
MM	Month number
DD	Day number of month
NAM	Day name in 3 characters
	(MON, TUE, WED, THU, FRI, SAT, SUN, or blank)

EXAMPLE: DAYDAT790727FRI would process data for Friday, the 27th of July 1979.

NOTE: Commercial 4Jx systems should input the day-date as MMDDYY.

4.2.1.2.2 Weekly Processing. If this option is selected, the data card must be as follows:

WEEKLY

Where:

WEEKLY = Required literal

This option will combine a weeks worth of data into one set of output charts. It will not put out a separate chart for each day of the week.

4.2.2 RMDR2 Outputs. Three outputs are produced by RMDR2: (1) reformatted RMON data to be passed to RMDR3, (2) error reports, (3) echo print of input data.

4.2.2.1 RMDR2 - Reformatted RMC Data (File OT). This file contains all the data that has been processed by RMDR2 and is ready for the graphic routine, RMDR3.

4.2.2.2 RMDR2 - Error Reports (File RP). This file contains a listing of any values that exceed the user specifications on the CONFIG card. RMDR2 will analyze all the RMON data, collect it into 15 minute timeframes, and compare it to the CONFIG card values. Any data that is greater than the figures read in on the CONFIG card will be highlighted. Values for memory, processor, tape channel usage, or disk channel usage, which exceed the CONFIG card value by less than 10 percent, are truncated to the CONFIG card value and noted on this report. If they exceed the value by more than 10 percent, they are dropped. Any other value which exceeds the value on the CONFIG card is also dropped and is noted on this report. (See figure 4-5.)

4.2.2.3 RMDR2 - Input Data Echo Print (File P*). This report just echo prints any value input. (See figure 4-6.)

4.2.3 RMDR2 Deck Setup. The following control cards are required to execute RMDR2:

```
$       SNUMB
$       IDENT
$       USERID
$       OPTION      COBOL
$       SET         9
$       SELECT      B29IDPX0/RMON/OBJECT/RMDR2
$       EXECUTE     DUMP
$       LIMITS      25
$       PRMFL       IN,R,S,CAT/FILE/STRING FOR SORTED RMON DATA
$       FILE        OT,FIS,20L
$       SYSOUT      RP
$       DATA        CD
CONFIG ANYSYS 08 2 3 8 18 07 100 100 48 072100 019000 015100
$       DATA        DT
DAYDAT790416MON
$       FILE        TC,NULL
```

4.3 RMDR3

RMDR3 reads the formatted RMDR2 data and prints graphs for 16 values.

4.3.1 RMDR3 Inputs. The RMDR3 requires two inputs: (1) formatted data from RMDR2 ($FILE:OT,FIS,20L), (2) a data card specifying which graphs to process (File-$DATA:CD).

DATE 11-13-79 UNCLASSIFIED

DATA ANALYSIS ERROR REPORT PAGE 1

TIME	DATA FIELD	VALUE	LIMIT	DISPOSITION
13.95	MASTER PROC TIME	234.4	200.0	DROPPED
14.18	MASTER PROC TIME	221.5	200.0	DROPPED
14.19	MASTER PROC TIME	203.3	200.0	TRUNCATED
14.26	MASTER PROC TIME	212.9	200.0	TRUNCATED
14.52	MASTER PROC TIME	201.6	200.0	TRUNCATED
14.86	MASTER PROC TIME	220.1	200.0	DROPPED
15.53	MASTER PROC TIME	200.1	200.0	TRUNCATED

Figure 4-5. RMDR2 Error Report

```
START TIME  00
STOP  TIME  23
CONFIG CARD - CONFIG ANYSIS  08 2 3 8 18 07 100 100 48 072100 019000 015100
08 64K BLOCKS MEMORY OR 512K
2 PROCESSORS
3 TAPE CHANNELS, 18 TAPE DRIVES
8 DISK CHANNELS
07 PRINTERS
MAX OF 100 TSS USERS ALLOWED
MAX OF 100 JOBS IN SYSTEM SCHEDULAR
SCALE FACTOR OF 48
072100 LINKS OF PERM STORAGE CONFIGURED
019000 LINKS OF SPARE STORAGE CONFIGURED
015100 LINKS OF REMOVABLE STORAGE CONFIGURED
ACTUAL START TIME 00.02
ACTUAL STOP  TIME 23.99
```

Figure 4-6. RMDR2 Input Data Echo Print

4.3.1.1 RMDR3 - Formatted Data (File IN). This sequential file contains the RMDR2 formatted RMON data.

4.3.1.2 RMDR3 - Requested Graphs (File CD). This input parameter card allows the user to specify which graph will be produced. The data card options are shown:

REPORTXXXXXXXXXXXXXXX

Enter a Nonblank character for each report to be turned on. The reports, in order of production, are:

Card Column		Input Value
1-6	=	REPORT - (Required literal)
7	=	Processor Utilization
8	=	Memory Utilization
9	=	Jobs in Execution
10	=	Jobs Swapped
11	=	Jobs Waiting Memory
12	=	Jobs Waiting PALC
13	=	Active Jobs in Scheduler
14	=	"HOLD" Jobs in Scheduler
15	=	TSS Users
16	=	TSS Processor Usage
17	=	TSS Memory Utilization
18	=	Tape Channel Utilization
19	=	Tape Drive Allocation

20	=	Printer Utilization
21	=	Disc Channel Utilization
22	=	Disc - LKS in Thousands

4.3.2 RMDR3 Outputs. Two outputs are produced by RMDR3: (1) input report (File PX), (2) graphs (File RP).

4.3.2.1 RMDR3 - Input Report (File P*). This report echo prints the REPORT Card used as input by the user. It also lists any graph turned off by the user. (See figure 4-7.)

4.3.2.2 RMDR3 - Graphs (File RP). The RMDR3 produces up to 16 graphs. Each graph contains the following: System name, date (range of days if Weekly option used for RMDR2, day of week if included in input to RMDR2), graph title, summary of graph maximum, and average values over eight hour segments of time (0-8, 8-16, 16-24) and over full day, Y-axis increment if not equal to one, start and stop time of data, time increment of each bar (normally 14.98 minutes). A bar is normally plotted for each 15 minutes of data. The time of day is printed at the bottom of each graph. The Y-axis range is produced on the right and left sides of each graph. Unless stated in the graph heading, each graph point is one unit of measurement. Figures 4-8 through 4-23 show all the reports.

4.3.2.2.1 Processor Utilization. This graph shows how busy all processors were during the collection period. The maximum value on the graph is the number of processors times 100%. Three different values are plotted: S - system jobs (see subsection 4.1.1 for explanation of system jobs), * - slave jobs, T - TSS.

4.3.2.2.2 Memory Utilization. This graph shows how memory was used during the collection period. The three values plotted in this graph are the same as in the Processor Utilization graph.

4.3.2.2.3 Jobs in Execution. This graph shows the number of jobs (S - system, * - slave) in execution during the monitored period.

4.3.2.2.4 Jobs Swapped. This graph shows the number of jobs (S - system, * - slave) swapped during the monitored period.

4.3.2.2.5 Jobs Waiting Memory. This graph shows all jobs (S - system, * - slave) that waited memory.

```
REPORT CARD - REPORTXXXXXXXXXXXXXXX
DISC LINKS          NOT GRAPHED
```

Figure 4-7. RMDR3 Input Report

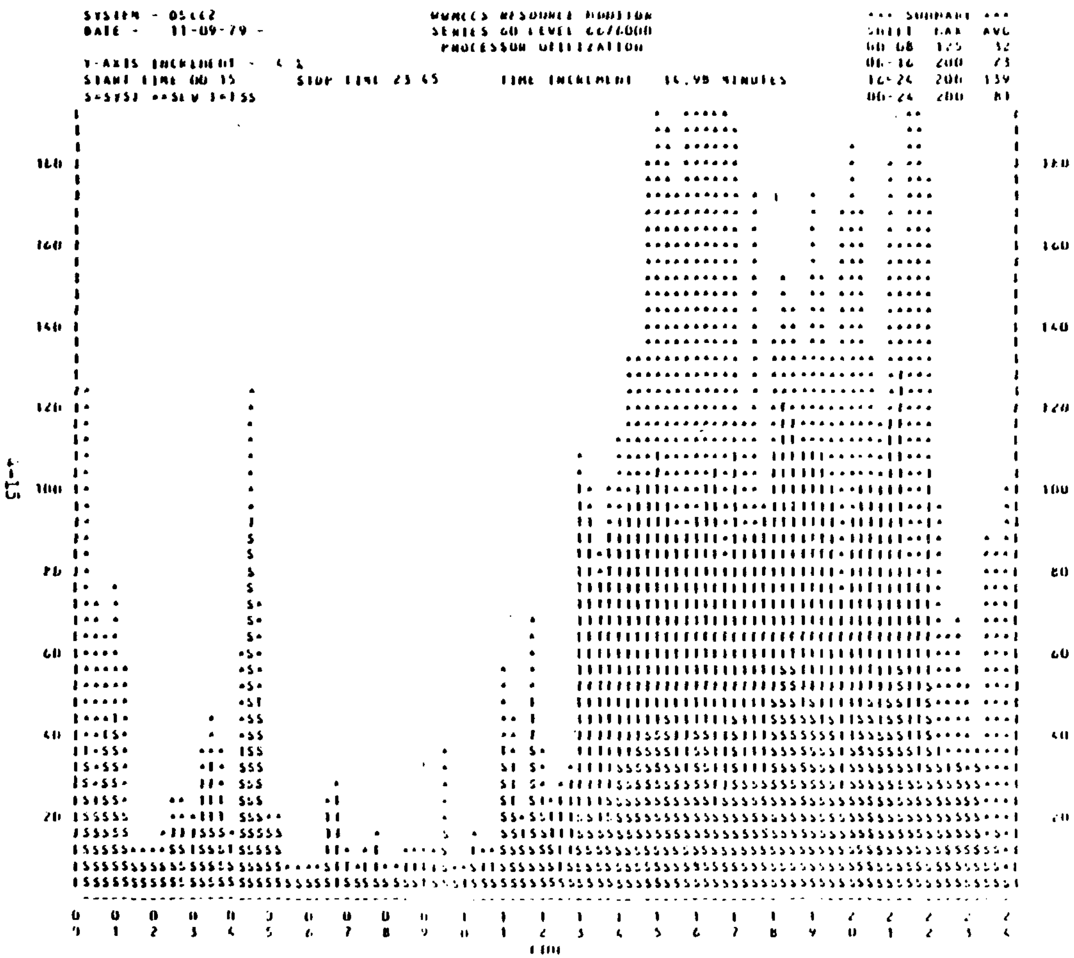


Figure 4.8. Processor Utilization

unclassified

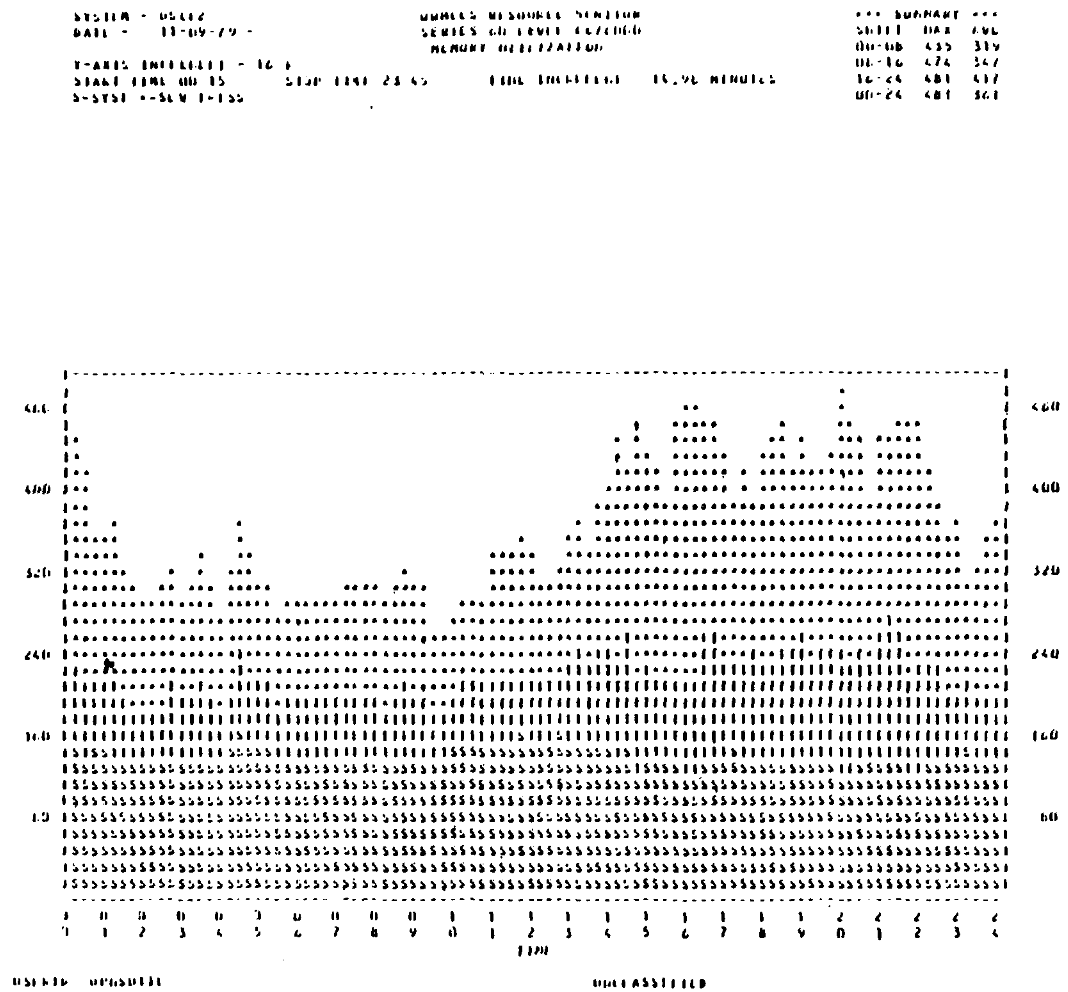


Figure 4-9. Memory Utilization

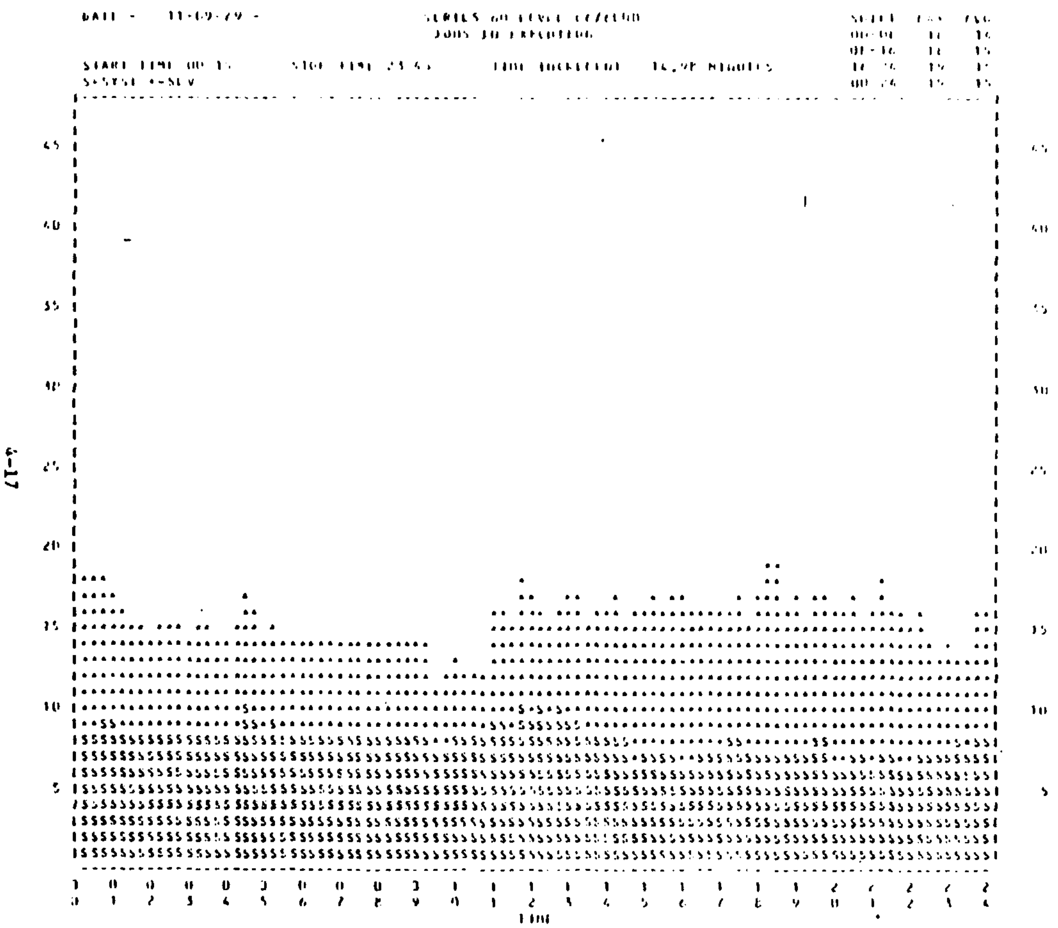


Figure 4-10. Jobs in Execution

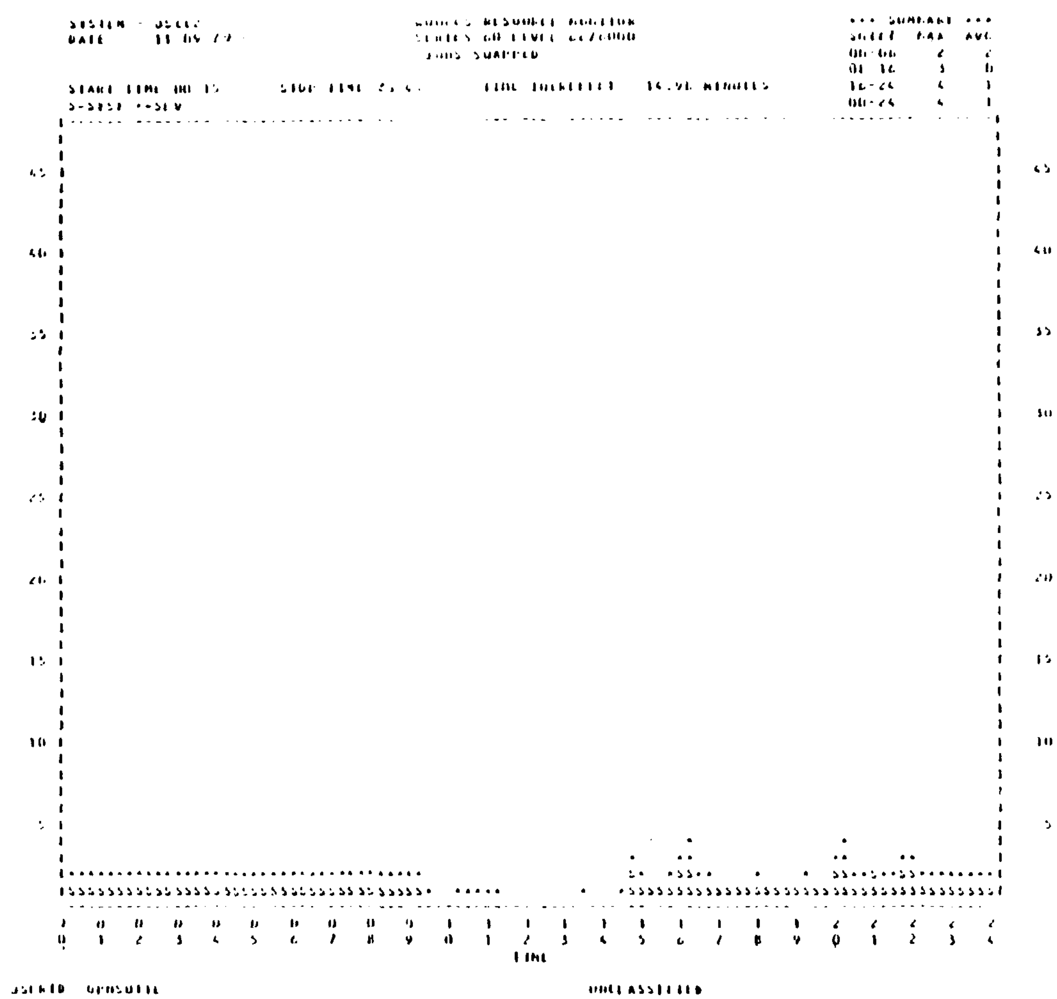


Figure 4-11. Jobs Swapped

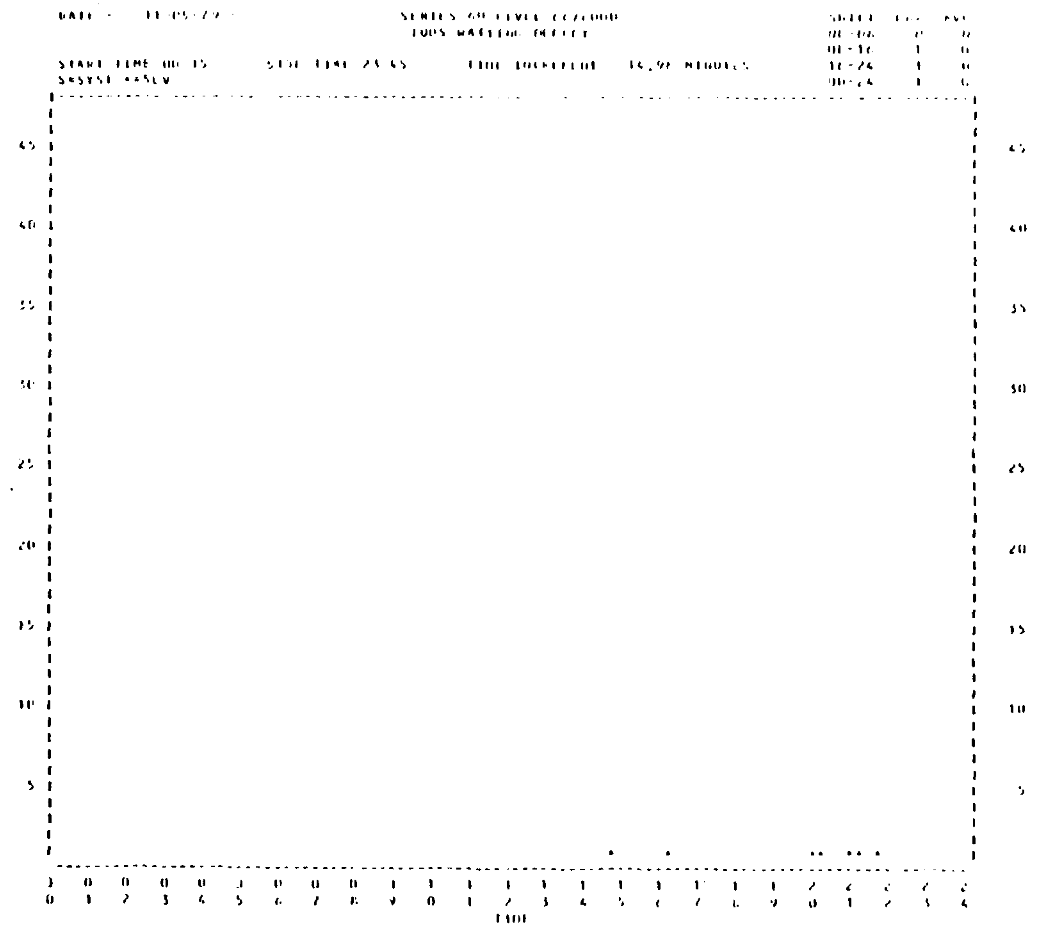


Figure 4-12 Jobs Waiting Memory

unclassified

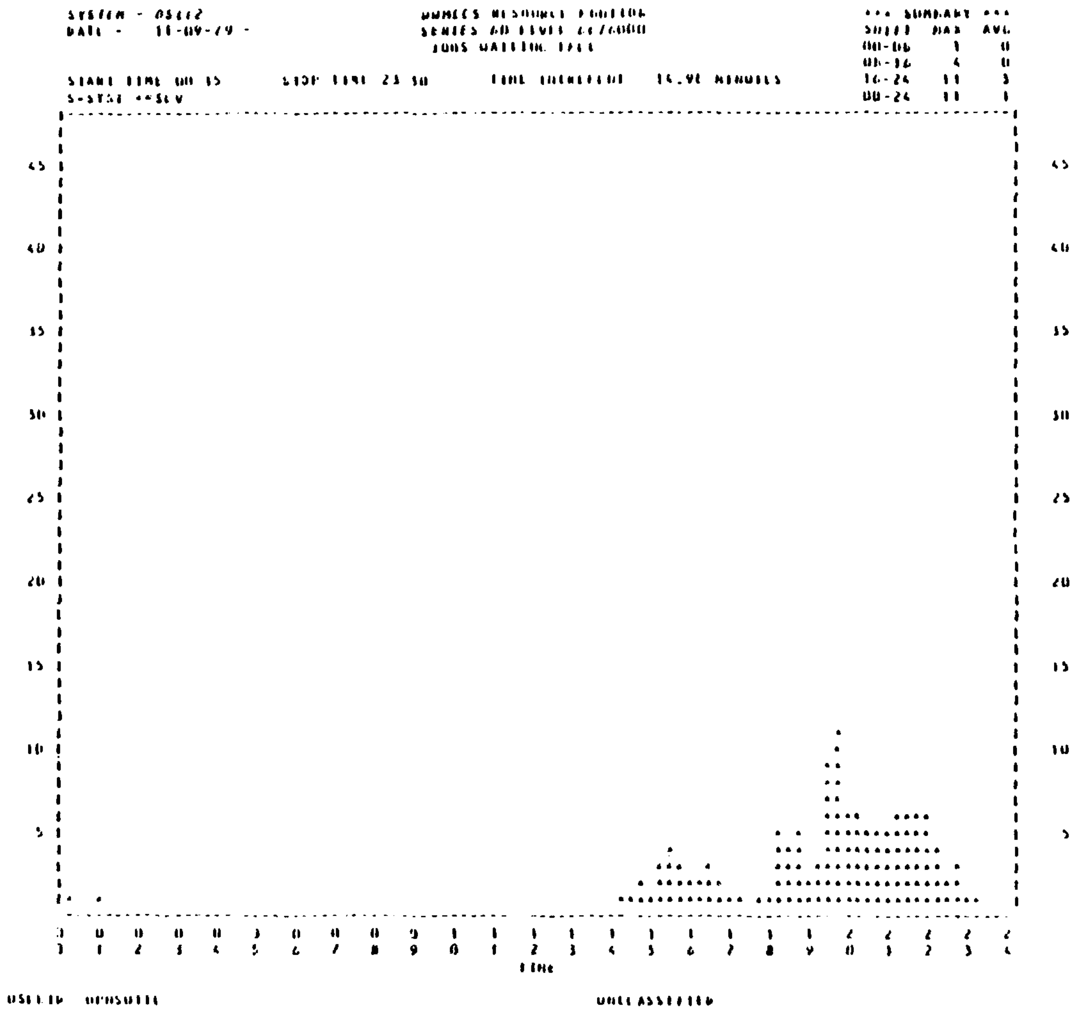
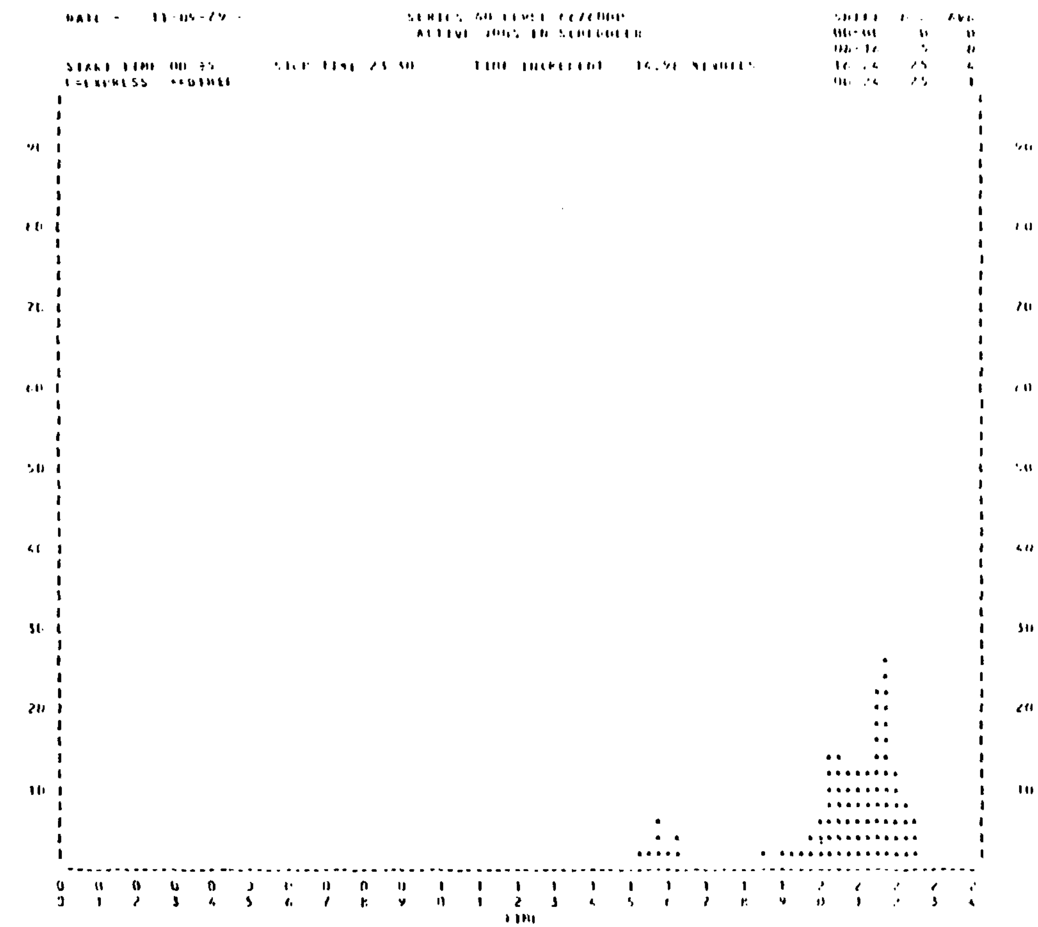


Figure 4-13. Jobs Waiting PALC



UNCLASSIFIED

Figure 4-14. Active Jobs in Scheduler

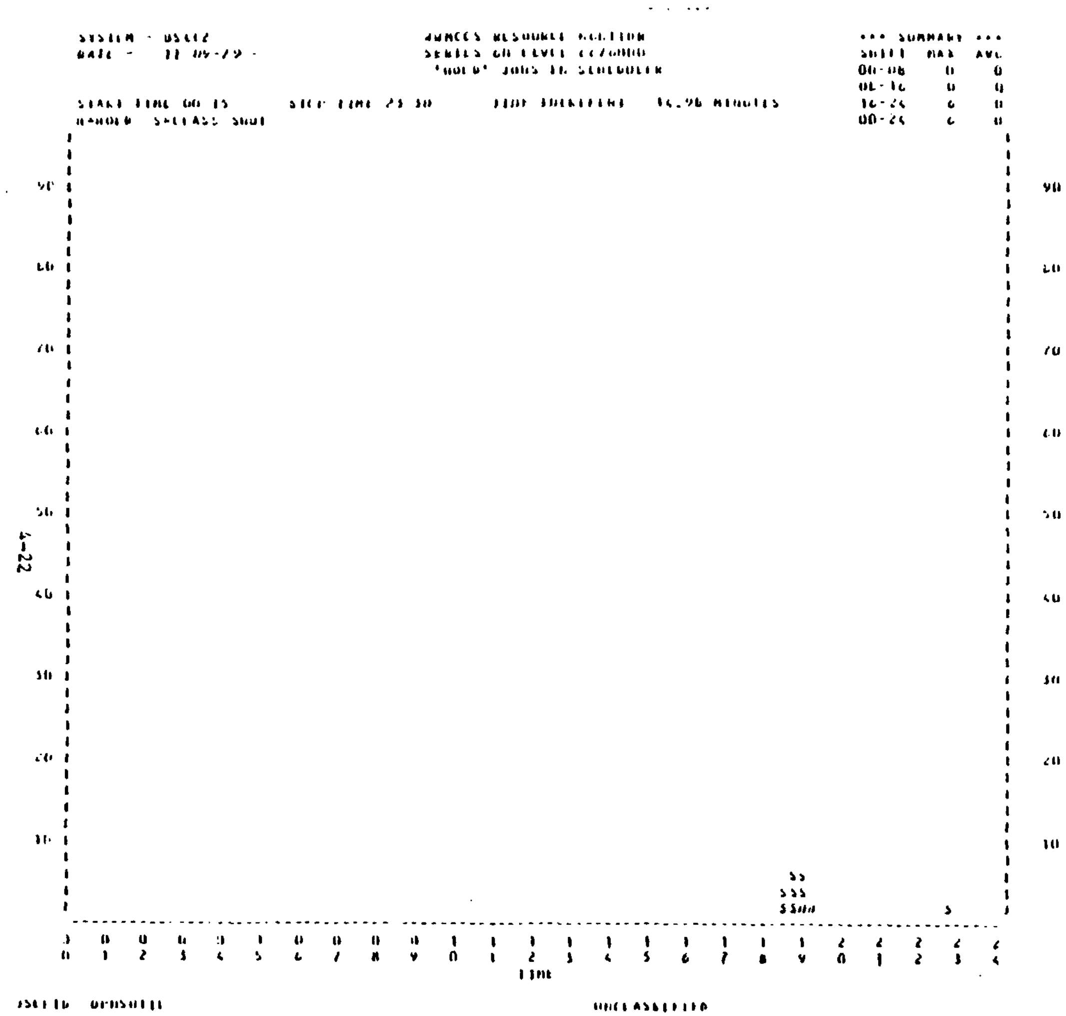


Figure 4-15. Hold Jobs In Scheduler

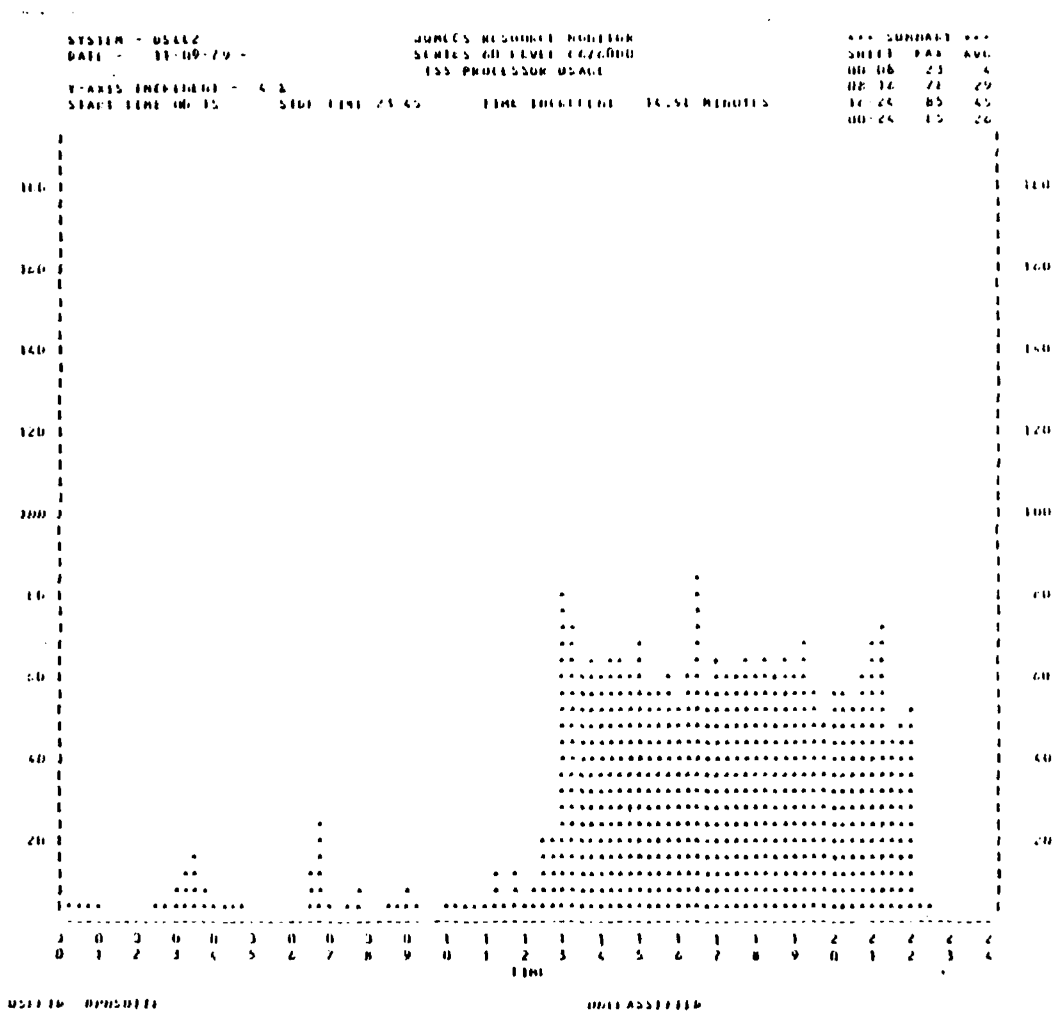


Figure 4-16. TSS Processor Usage

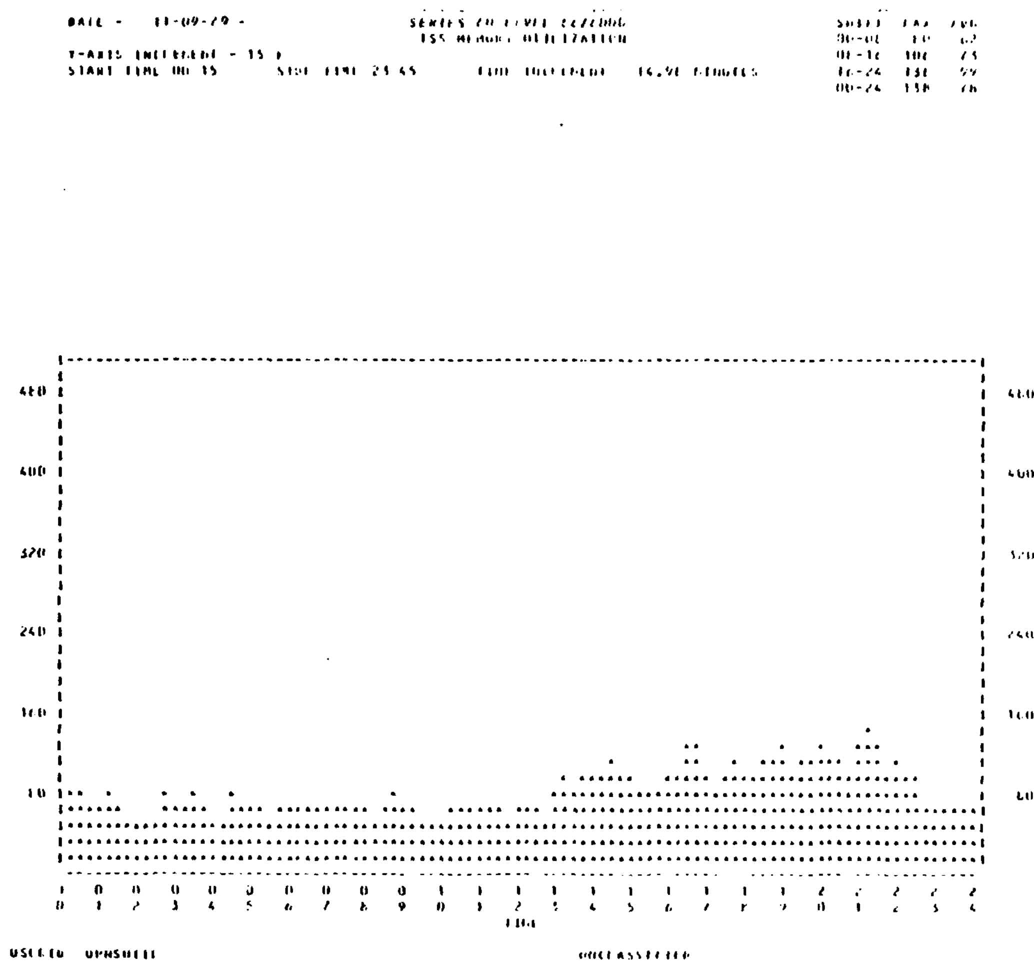


Figure 4-17. TSS Memory Utilization

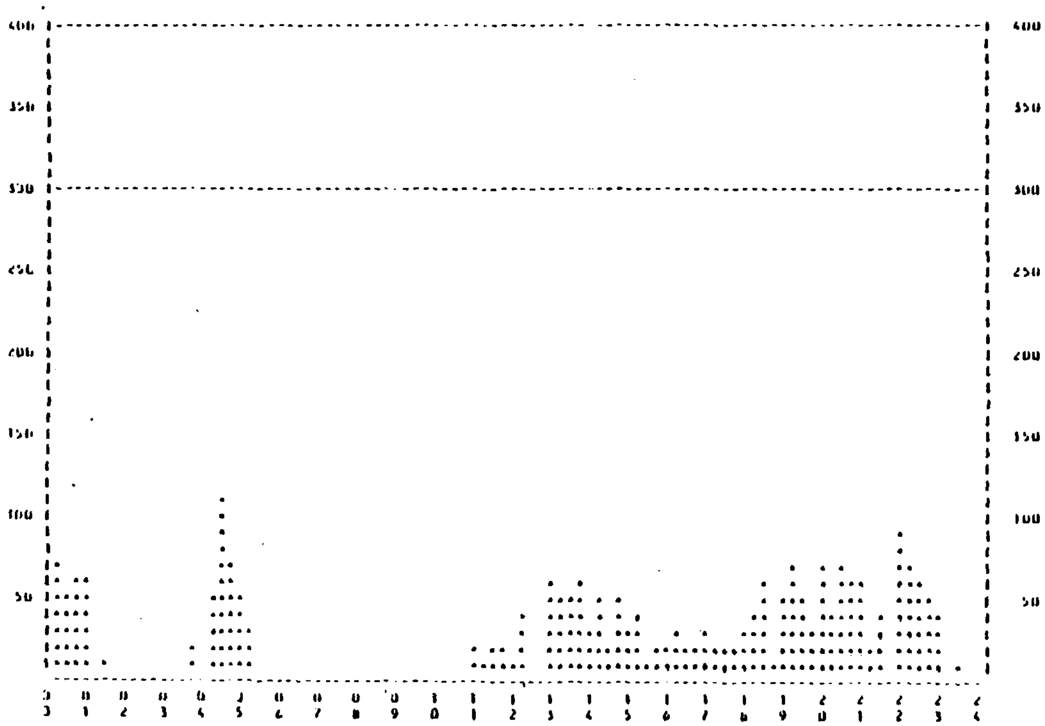
DATE - 11-09-79 -

GRAMES RESOURCE MONITOR
SERIES 60 LEVEL 66/6000
TAPE CHANNEL UTILIZATION

Y-AXIS INCREMENT - 13 %
START TIME 00 15   STOP TIME 23 45   TIME INCREMENT 14.96 MINUTES

*** SUMMARY ***

SHIFT	MAX	AVG
00-08	106	16
08-16	60	19
16-24	86	37
00-24	106	24



UNCLASSIFIED

Figure 4-18. Tape Channel Utilization

SYSTEM - ...
DATE - 11-09-79

WWMCCS RESOURCE ...
SERIES 60 LEVEL 6/7000
TAPE DRIVE ALLOCATION

START TIME 00:15   STOP TIME 23:45   TIME INCREMENT 15.5 MINUTES
U=UNAVAIL. D=DEDICATED

*** SUMMARY ***

SHIFT	MAX	AVG
00-08	3	0
08-16	4	1
16-24	7	3
00-24	7	1

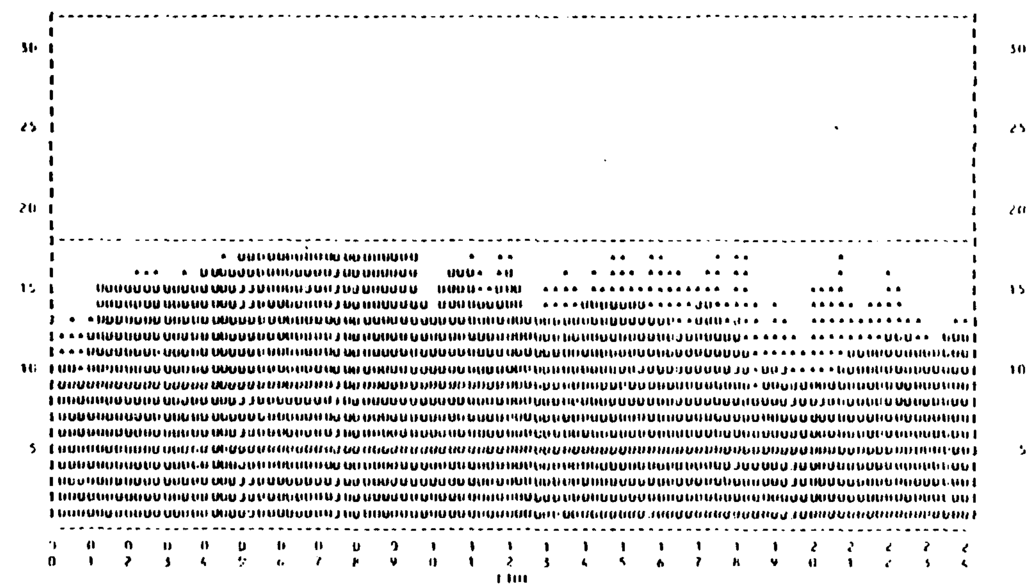


Figure 4-19. Tape Drive Allocation

unclassified

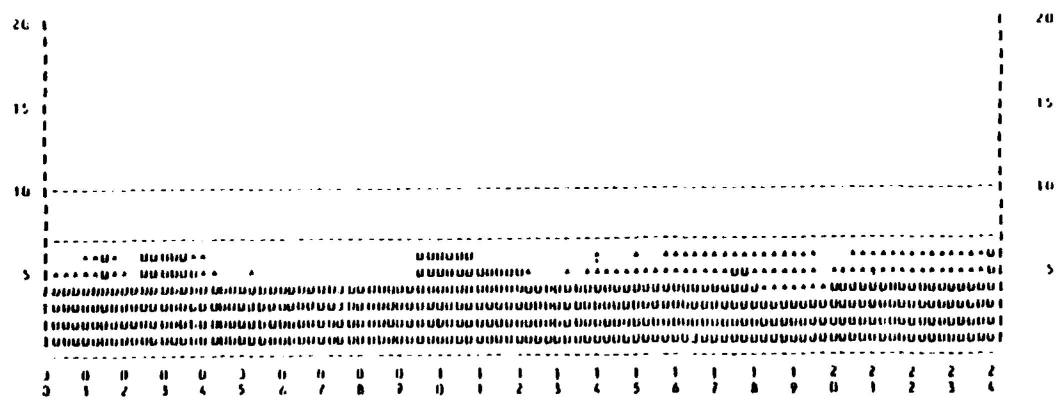
SYSTEM - [illegible]
DATE - 11-05-79 -

WWMCCS RESOURCE MONITOR
SERIES 60 LEVEL 66/6000
PRINTER UTILIZATION

START TIME 00.15   STOP TIME 23.45   TIME INCREMENT 14.98 MINUTES
UNCLASSIFIED

*** SUMMARY ***

SHIFT	MAX	AVG
00-08	2	0
08-16	2	0
16-24	3	1
00-24	3	0



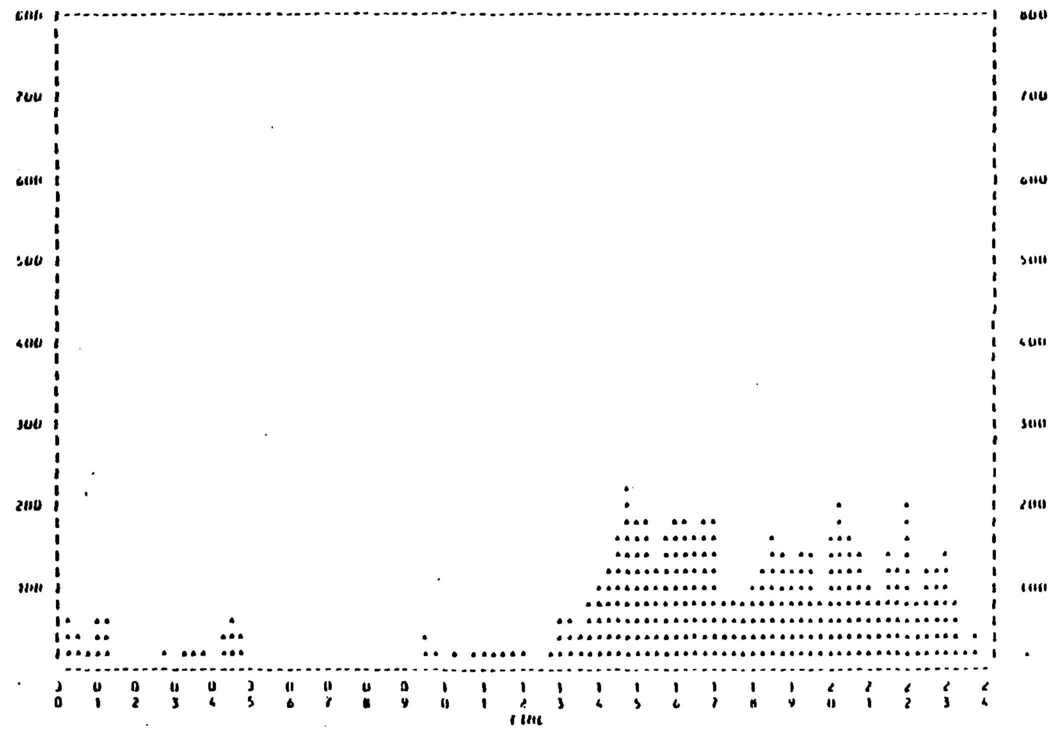
UNCLASSIFIED

Figure 4-20. Printer Utilization

DATE - 11-09-79 -   SERIES 60 LEVEL 66/6000
DISC CHANNEL UTILIZATION

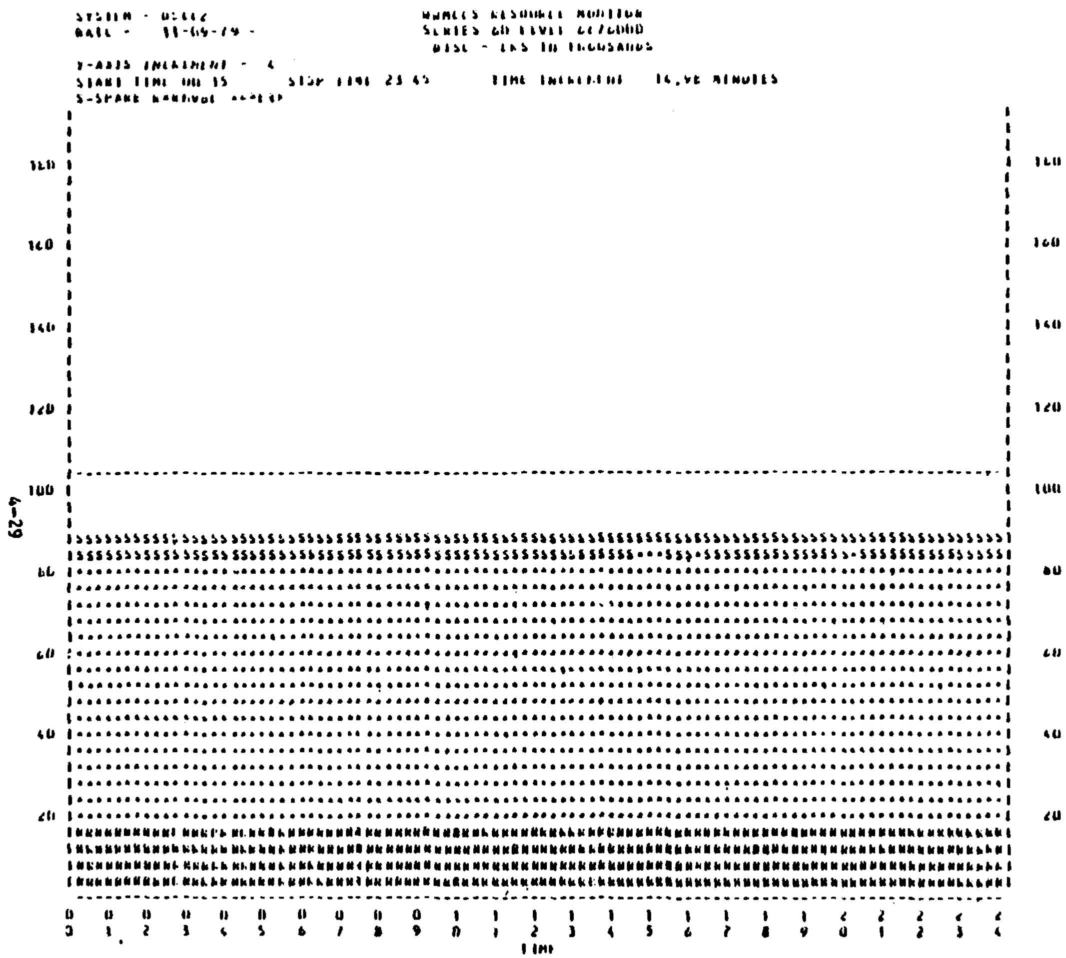
Y-AXIS INCREMENT - 23 %
START TIME 00 15   STOP TIME 23 45   TIME INCREMENT 14.98 MINUTES

SHIFT	MAX	AVG
00-08	65	17
08-16	217	59
16-24	203	121
00-24	217	66



USERID OPNSUTIL

Figure 4-27. Disc Channel Utilization   unclassified



UNCLASSIFIED

Figure 4-22. Disc LKS in Thousands

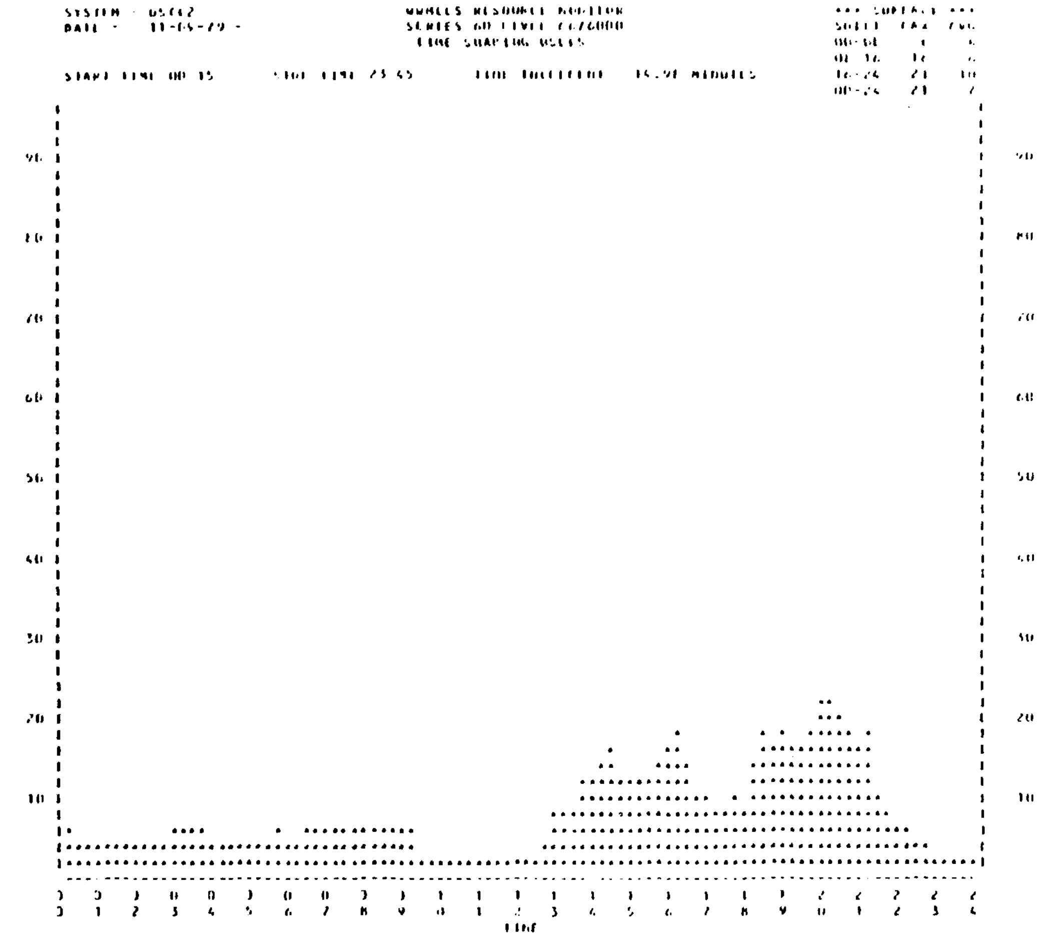


Figure 4-23. TSS Users

unclassified

4.3.2.2.6 Jobs Waiting PALC. This graph shows all jobs (S - system, * - slave) that waited peripheral allocation.

4.3.2.2.7 Active Jobs in Scheduler. This graph shows all active jobs waiting in the scheduler. The two values graphed are jobs in the Express queue (E) and all other queues (*).

4.3.2.2.8 Hold Jobs in Scheduler. This graph shows all the jobs that were put into the HOLD class of the system scheduler. The two values graphed are jobs in the HOLD class (H) and jobs in the user normal class that have been shut (S). A class that has been shut off by use of the JEND verb is not considered "SHUT." Only classes explicitly shut or open (number of jobs allowed in the system) are considered.

4.3.2.2.9 TSS Users. This graph shows the number of users logged onto TSS during the monitoring period.

4.3.2.2.10 TSS Processor Usage. This graph shows the percentage of the processor power used by TSS. This is an extension of the Processor Utilization graph.

4.3.2.2.11 TSS Memory Utilization. This graph shows the percentage of memory used by TSS. This is an extension of the Memory Utilization graph.

4.3.2.2.12 Tape Channel Utilization. This graph shows the tape channel utilization of the total tape channel configuration.

4.3.2.2.13 Tape Drive Allocation. This graph shows the number of tape drives in use. The three values plotted show those drives that are dedicated (D), unavailable (U), which can mean they are released or being used for T&D, or in use (*).

4.3.2.2.14 Printer Utilization. This graph shows the number of printers in use. The three values plotted show those printers that are dedicated (D), unavailable (U), or in use (*).

4.3.2.2.15 Disc Channel Utilization. This graph shows the disc channel utilization of the total disc channels configured.

4.3.2.2.16 Disc LKS in Thousands. This graph shows the variability of the links configured on the system. The three values plotted are removable links (R), permanent links (*), space and scratch links (S). The Y increment gives the value of each character graphed.

4.3.3 RMDR3 - Deck Setup. The following control cards are required to execute RMDR3:

```
$       OPTION      COBOL

$       SELECT      B29IDPXO/RMON/OBJECT/RMDR3

$       EXECUTE

$       LIMITS      25,26K,20K

$       FILE        IP,F2R,200L

$       FILE        IN,F1R,20L      Input from RMDR2

$       FILE        S1,S1R,20R

$       SYSOUT      RP

$       DATA        CD

REPORTXXXXXXXXXXXXXXXX
```

SECTION 5. THE GENERAL MONITOR COLLECTOR - DATA COLLECTION PROGRAM

5.1 Introduction

The General Monitor Collector (GMC) data collection program is a privileged slave program which processes GCOS system trace data, organizes the data in GMC records, and writes the collected GMC data records on its output magnetic tape. The general concept of operation for the GMC facility is shown in figure 5-1.

As a privileged slave program, the monitor data collector requires the permission of the system operator to run and must execute in master mode. The master mode capability allows the GMC to access all of the system main memory. The areas of interest are the system Communication Region (CR) and the individual job Slave Service Areas (SSAs).

The GMC is actually a series of independent data collection monitors which are controlled via the central Executive Routine (ER) (described in subsection 5.3.1), and which use a common buffering routine for writing collected data to a common tape. The current GMC is comprised of nine different monitors, which can be executed independently, or in any combination. The monitors are described in this section. Each of the monitors has a dedicated data reduction program that produces formatted reports. These data reduction programs are described in sections 6 through 12.

The GMC can obtain control from the system in one of three ways. First, the standard manner is for the GMC to obtain control via the normal system trace. Second and third, GMC may also gain control in two nonstandard manners. These are via internally created system sub-traces (referred to as IT traces) and direct transfer patches (referred to as DT traces).

In the first way, the standard mechanism used by the monitor for obtaining control from the operating system is the normal GCOS system trace. The system trace capability records a history of the occurrence of as many as 72 system events, 64 of which are presently defined. This recording takes place in a circular table in the Communication Region of memory and is accomplished by execution of a unique code set resident in the system Dispatcher Module (.MDISP). Execution of this code is common to all system trace events and provides the point at which the GMC obtains control. The initialization portion of the GMC locates the system trace code set and implants a transfer instruction to the GMC executive. Thus, whenever a system trace event occurs anywhere within the system, the GMC executive will obtain control.

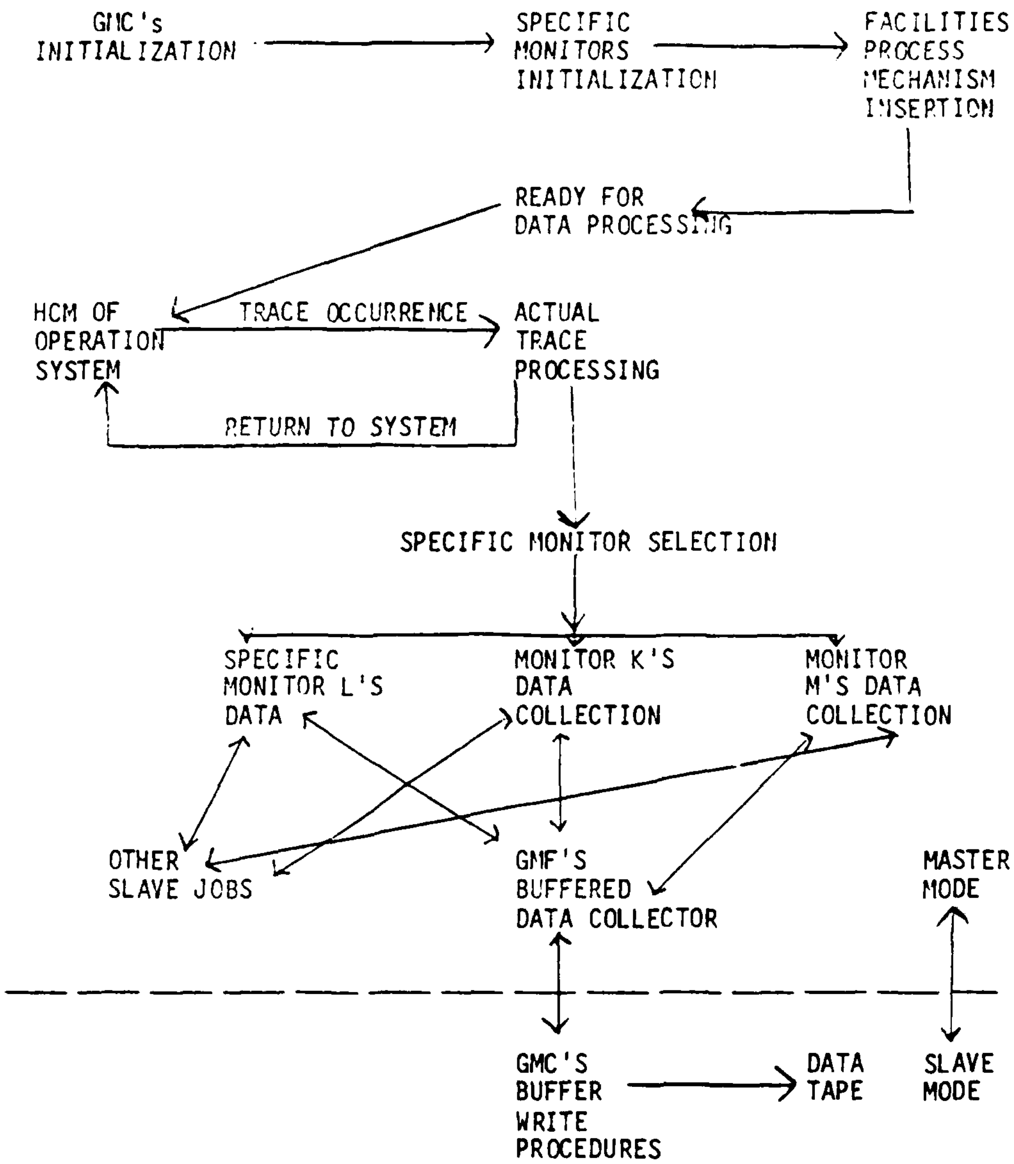


Figure 5-1. GMC Concept

After obtaining control, the system trace recording is completed using normal system procedures and then the trace is investigated. If an executing GMF monitor requires this trace type, control is given to that monitor. The monitor then collects data of interest to itself and requests the GMC executive to buffer the data. When the monitor completes its task, it returns control to the GMC executive. The GMC executive then transfers control back to the system trace processing routine within the GCOS dispatcher. The activities mentioned above take place in master mode under the guise of an extension of normal system trace procedures.

The second method used by GMC to gain control is for GMC to create its own system traces. The GMC will search a given GCOS module for a known line of code. It will replace this line of code with a transfer to a patch area. In the patch area, the monitor will insert code to create a new GMC system trace. At this point, the execution of this code will be processed just as all other system traces are processed. This procedure is used only when the Communication Analysis Monitor is selected for execution. (See subsection 5.2.6 for a complete description of this procedure.)

The third method used by GMC to gain control is via a direct transfer from a GCOS module. In this case, GMC will search a given GCOS module for a known line of code. It will replace this line of code with a direct transfer into the GMC. This can be accomplished since GMC is locked in core during its entire execution. The benefit of this procedure is that the overhead of the system trace is eliminated. This procedure is used only when the Mass Store Monitor or the CPU Monitor is selected for execution. (See subsections 5.2.2 and 5.2.3 for a complete description of this procedure.)

As the GMC ER buffers the collected monitor data, it will determine when one of the internal buffers are filled and must be written to tape. At this point, it will establish a normal slave dispatch to its tape writing facility. The tape writing facility will then write the internal buffer to tape and signal the executive that this buffer may be reused.

5.2 GMC Monitor Subroutines

In this subsection, each of the nine monitor subsystems will be addressed. Each subsystem requires that specific trace types be enabled in the H6000 system boot deck on the $ TRACE card. A detailed discussion of the computer system boot deck used for startup and $ TRACE operations is contained in the GCOS System Startup Manual and in the System Tables Manual. GMC cannot be used to turn on or off a TRACE option. The GMC user must request the computer system manager to change the system boot deck $ TRACE card to meet the minimum GMC requirements. If all the required trace types are not on, GMC will abort with a T0 through T8 abort. The digit immediately following the letter T indicates the monitor number for

which the proper traces are not active. See table 5-1 for a quick reference of required trace types for each monitor and refer to table 5-2 for all GMC abort codes.

5.2.1 Memory Utilization Monitor. The Memory Utilization Monitor (MUM) is used to measure memory utilization. For a detailed description of reports containing data collected by this monitor, see section 6.

When MUM is active it is essential that GCOS system trace types (octal) 10, 11, 46 and 51 are enabled in the computer system boot deck $ TRACE card. MUM collects data upon the occurrence of those traces and builds its records which are then passed to the Executive Routine (ER) for buffering. A separate discussion of the format of the MUM collected data records is contained in subsection 5.4.2. MUM requires that at least the following segment numbers from table 5-3 be used to generate the GMC R* file:1, 2, 11, 19, 23, 26 and 27. The complete process for generating an R* file is described in subsection 5.6. It should be noted that this version of MUM will not collect any idle trace information and therefore not all MUM reports will be produced during data reduction. See section 6 for description of reports that will not be produced.

If the user wants all the MUM reports produced, then the Idle Monitor must be made active, along with the Memory Monitor. To do this, GCOS trace types (octal) 0, 1, 2, 3, 10, 11, 13, 16, 21, 22, 37, 46, 51 and 65 must be enabled. In generating the R* file the following segment numbers should be used: 1, 2, 10, 11, 19, 23, 24, 25, 26 and 27. It should be noted that when the Idle Monitor is active the amount of data collected will be about double that collected when the Idle Monitor is off. The user should carefully evaluate the need for those reports produced by the Idle Monitor.

The MUM is designed so that it can accurately report all changes to the memory subsystem. It does this by processing all trace type 10's (.CALL) and all trace type 11's (.GO TO). Upon receiving these traces a further check is made to see whether a memory allocation process is being requested i.e. the use of SSA modules: .MPOP3,.MPOQ4, or MPOR5. The MUM will collect data only if one of these modules has been requested.

The first item of information reported by the MUM is the current status of all jobs waiting in the Peripheral Allocator's Queue. This information is reported so as to be better able to represent the true core demand being made by the current workload. When a GCOS system has a large number of jobs waiting core, a Core Damper Switch is set. This switch is used to prevent jobs from being sent from the Peripheral Allocator to the Core Allocator. Therefore, the Peripheral Allocator's queue may contain many jobs that would normally be in the Core Allocator's queue, were it not for the Core Damper Switch. This

Table 5-1. Required Trace Type for Each Monitor

Monitor # (octal)	Monitor	Required Trace Type
0	Memory Utilization Monitor (MUM)	10, 11, 46, 51, (Idle Monitor traces optional)
1	Mass Storage Monitor (MSM)	7, 15, 73*, 76*
2	CPU Monitor (CPUM)	10, 11, 21, 70*
3	Tape Monitor (TM)	50, 51, 52
4	Channel Monitor (CM)	4, 7, 15, 22 (Idle Monitor traces optional)
5	Communications Analysis Monitor (CAM)	14*
6	GRTS Monitor (GRTM)	62*
7	Idle Monitor (IDLEM)	0, 1, 2, 3, 13, 16, 21, 22, 37, 65
8	Transaction Processing System Monitor (TPSM)	0, 1, 2, 4, 5, 6, 13, 42, 51, 65, 74*

*These are not standard traces. They are specially created by the GMC or by an editing of the GCOS TPE Subsystem in the case of trace type 74. Trace types 70, 73 and 76 are direct transfers into the GMC and as such are not required to be active via the $ TRACE card in the system boot deck. Trace types 14, 62 and 74 do use the System Trace Function and require the Trace Number to be active on the $ TRACE card.

Table 5-2. Abort Codes (Part 1 of 3)

BC -	Illegal request on limited connect option.
BK -	Backspace of the full data tape was bad. Multireel will not be collected. Check for tape drive problems.
BS -	Bad tape status. Check condition of tape and rerun job.
C1 -	CPU Monitor turned off but SNUMB input requested on the data card.
C2 -	Illegal SNUMB (more then five characters) on data card.
C3 -	More then three SNUMBS for CPU Monitor on data card.
CD -	Illegal character in CAM special option.
CE -	Console message garbled. Check console sheet and check with operator.
CM -	Cannot move out of the growth range of TSS.
CO -	CAM turned off but special option requested.
DK -	No multireel disk file was present. Use a $ FILE card in the JCL or use the M9 option to turn off multireel capability.
DR -	Disk read-in. End-of-reel processing was bad.
DS -	Bad status of the disk write.
ER -	Wrapup record could not be written.
ET -	More than two terminals requested for CAM special option.
FN -	The IOS accounting modification could not be found. Call CCTC
GC -	No GRTS control card.
GD -	No FEP I/O can be performed.
GM -	Needed memory for GRTS Monitor denied. Increase $LIMIT card.
GO -	GRTS Monitor illegal data card.
GS -	Extra SSA is not available for GRTS Monitor. Check $ LIMIT card

Table 5-2. (Part 2 of 3)

M0-M8 - Monitor was not turned off and not present on the R* file. Any monitor not contained on the R* file must be turned off via the data card option. The number following the M is the monitor that was not turned off.

MM - The dispatcher hook has already been inserted. Another version of GMC must already be in execution.

N1 - The CPU Monitor hook code could not be found. See subsection 5.2.3.

N2 - Sufficient patch space is not available in .MDISP to run the CPU Monitor. See subsection 5.2.3.

N3 - DNWW/MDNET patch location could not be found. See subsection 5.2.6.

N4 - Sufficient patch space is not available in DNWW/MDNET to run the Communication Analysis Monitor. See subsection 5.2.6.

N5 - MSM patch for SSA cache analysis not found (AOS .CRTDL). See subsection 5.2.2.

N6 - MSM patch for SSA cache analysis not found (AOS .CRTBH). See subsection 5.2.2

N7 - MSM patch space in .MDISP not sufficient for monitoring SSA cache. See subsection 5.2.2.

N8 - CPU Monitor hook code for subdispatch could not be found. See subsection 5.2.3.

NF - The Dispatcher hook code could not be found. Call CCTC/C751.

OE - An error in an off option was encountered. Check the data cards.

OK - All went correctly.

OL - Overlap of disk file. Increase size of disk file. Check if operator failed to respond to tape mount message during multiprocessing.

OV - A tally overflow occurred in the MUM.T10 subroutine. Increase the size of the data area within subroutine MUM.T10, variable SIZEBUF.

Table 5-2. (Part 3 of 3)

RS -	Routine depth requested exceeded table length.
RW -	Error in initial rewind. Check tape and drive.
SB -	End-of-reel processing was bad. Check tape and drive.
SD -	Error setting of density.
SF -	Limited reel option termed successfully.
SQ -	Sequence error in the physical records.
S1 -	Subroutine MUM.T10 missing
S2 -	Subroutine MUM.T46 missing
S3 -	Subroutine CM.T07A missing
S4 -	Subroutine CPU.T70 missing
S5 -	Subroutine CM.T04A missing
S6 -	Subroutine CM.T22A missing
S7 -	Subroutine TM.T50 missing
S8 -	Subroutine CAM.T14 missing
S9 -	Subroutine GRT.T62 missing
SA -	Subroutine IDL.TRCS missing
SC -	Subroutine IDL.T21 missing
SD -	Subroutine TPE200 missing
TE -	The start/stop times appear improper. Check data card.
TL -	Trailer record write was bad. Check tape and drive.
TS -	An OK abort directed by a time to stop command.
TW -	The tally word has been garbled.
T0-T8 -	Required system trace is not on. The number following the T indicates the monitor having the problem.

Table 5-3. GMC Catalog and File Index (Part 1 of 3)

SEGMENT #	FILE	REQUIRED	FUNCTION
1	GMF.TOP	Y	Read data card, initialization, find hook in dispatcher, and create initial record
2	MUM.INIT		Initialize Memory Monitor
3	MSM.INIT		Initialize Mass Store Monitor
4	CPU.INIT		Initialize CPU Monitor
5	CAM.INIT		Initialize Communications Analysis Monitor
6	CM.INIT		Initialize Channel Monitor
7	TM.INIT		Initialize Tape Monitor
8	GRT.INIT		Initialize DN-355 Monitor
9	TP.INIT		Initialize TPE Monitor
10	IDL.INIT		Initialize Idle Monitor
11	GMF.MID	Y	Ensure at least one active monitor
12	CAM.PAT		Preparation for patching DNWW/MDNET for Communications Analysis Monitor
13	CPU.PAT		Preparation for patching dispatcher for CPU Monitor
14	MSM.PAT		Preparation for patching dispatcher for MSM Cache Analysis
15	PATLOOK		Searches for patch space for CPUM, CAM, MSM
16	CPUDOIT		Patch the dispatcher for CPU Monitor
17	CAMDOIT		Patch DNWW for Communication Analysis Monitor
18	MSMDOIT		Patch dispatcher for MSM Cache Analysis

Table 5-3. (Part 2 of 3)

SEGMENT #	FILE	REQUIRED	FUNCTION
19	GMF.MON	Y	Insert the trace hook for GMC traces
20	CPU.REMO		Remove CPU Patches to dispatcher
21	CAM.REMO		Remove CAM patches to DNWW/MDNET
22	MSM.REMO		Remove MSM patches to dispatcher
23	GMF.BTM	Y	Remove the trace hook, do all IO control
24	IDL.TRCS		Processes traces, 0,1,2,3,13,16,22,37, and 65 for Idle Monitor
25	IDL.T21		Processes trace 21 for Idle Monitor
26	MUM.T10		Processes traces 10, 11, and 51 for Memory Monitor
27	MUM.T46		Processes trace 46 for Memory Monitor
28	CPU.T70		Processes traces, 10,11,21, and 70 for CPU Monitor**
29	TM.T50		Processes traces 50,51,52 for Tape Monitor
30	CAM.T14		Processes trace 14 for CAM*
31	CM.T04A		Processes trace 4 for Channel Monitor
32	CM.T22A		Processes trace 22 for Channel Monitor
33	CM.T07A		Processes traces 7,15,73,76 for Channel Monitor and Mass Store Monitor**
34	GRT.T62		Processes trace 62 for GRTS Monitor*
35	GRT.COL		Interfaces with the DN-355

Table 5-3. (Part 3 of 3)

SEGMENT #	FILE	REQUIRED	FUNCTION
36	TPE200		Processes traces 0,1,2,4,5,6,13,42,51,65 and 74 for TPS Monitor*
37	RUN.GMF		JCL to run a GMC R*
38	GMF.OBJ		File to contain a GMC R*
39	MAKE.XXX		A series of files creating different GMC R* Monitors.
39A	MAKE.MUC		Memory and CPU Monitors
39B	MAKE.ALL		Total GMC
39C	MAKE.MUM		Memory Monitor
39D	MAKE.CPU		CPU Monitor
39E	MAKE.TM		Tape Monitor
39F	MAKE.MSM		Mass Store Monitor
39G	MAKE.MCC		Memory, CPU, Communications and Idle Monitors
39H	MAKE.MCI		Mass Store, Channel and Idle Monitors
39I	MAKE.CAM		Communications Analysis Monitor
39J	MAKE.CM		Channel Monitor
39K	MAKE.GRT		DATANET-355 Monitor
39L	MAKE.CMI		Channel and Idle Monitors
39M	MAKE.MCM		Mass Store and Channel Monitors
39N	MAKE.GC		Communications and DATANET Monitors
39O	MAKE.TPE		TPE Monitor

*Trace types 14,62 and 74, are not standard. They are internally generated (IT) traces.

**Trace types 70,73 and 76 are not standard. They are direct transfer (DT) traces.

information from the Peripheral Allocator is reported only when the Peripheral Allocator is in memory and a Memory Monitor trace is about to be generated. For this reason, not all Peripheral Allocator queue changes will be reported. In order to reduce the amount of information being collected, a job's status in the Peripheral Allocator's queue is reported only for new jobs, when a job has changed activity, or when its status has changed.

After reporting any Peripheral Allocator status information, the MUM will next report the status of every job waiting for or currently using memory. Information such as the SNUMB, IDENT, USERID, Activity Number, memory demands, current memory address, whether the job is in memory or waiting for memory, and whether the job is a system program or user program is collected. This information is reported for each job only if a change has occurred from previous information that was reported. In addition, the current amount of CPU and IO time used by a job is reported in every MUM trace that is generated.

The MUM will consider a job to be a system job if it has a program number less then octal 10, or if it has no J* file and requires privity. Since the user may want to consider other jobs to be system jobs, such as HEALS or VIDEO, the data reduction program allows the user to extend this definition of system jobs (see section 6).

5.2.2 Mass Storage Monitor. The Mass Storage Monitor (MSM) is used to collect data on usage of peripheral resources. For a detailed description of reports containing data collected by this monitor, see section 7.

When the user wants MSM to be active, it is essential that trace types (octal) 7 and 15 are enabled in the computer system boot deck on the $ TRACE card. MSM processes trace types 7, 15, 73, and 76 to build its own records which are passed to ER. A separate discussion of the format of the MSM collected data records is contained in subsection 5.4.3. As has been stated earlier, trace types 73 and 76 are direct transfer traces created by the GMC, and as such need not be defined on the $ TRACE card. The MSM requires that at least the following segment numbers from table 5-3 be used to generate the GMC R* file: 1, 3, 11, 14, 15, 18, 19, 22, 23, and 33. The complete process for generating an R* file is described in subsection 5.6. If the system being monitored by the Mass Store Monitor contains SSA Cache Core, two new direct transfer traces, are created by the Mass Store Monitor in order to collect sufficient data to be able to analyze the operation of SSA Cache Core. These traces are created only if SSA Cache Core is configured. The Mass Store Monitor searches the dispatcher for a AOS .CRTDL instruction and then inserts code to make a direct transfer into the GMF. In addition, an AOS .CRTBH instruction is also searched for so that another direct transfer into the GMC can be generated. The first instruction locates the area of the dispatcher where it has been determined that the required SSA module is not in the SSA Cache Buffer and needs to be loaded from disk. The second instruction

locates that area of the dispatcher where it has been determined that the required SSA module is in the SSA Cache Buffer. The search for these instructions begins at octal location 4600 in WW6.4 or 7164 in WW7.2 and continues to octal location 5100 in WW6.4 or 7464 in WW7.2 within the dispatcher. If GMC cannot find these instructions between these locations, it will abort with an N5 or an N6 abort. If this problem occurs, the dispatcher code should be examined to see if this instruction has been moved or modified. If so, the code in GMC will need to be altered.

The above searches do not occur if a search of ILIST finds a routine by the name of DBASE. In this case, the search starts at that address and continues for 300 octal locations. The lower half of word 7 of the dispatcher contains the address of a 10-word table, called ILIST, which points to conditionally loaded routines in the dispatcher. The first word of each routine is a BCD constant identifying that routine. During system startup, the dispatcher compresses itself to eliminate unnecessary routines (e.g. priority B if bit 18 in word 0 is not set). The search by absolute locations is done only if a search of ILIST does not find the desired routine.

Upon finding the above sets of instructions, GMC searches the dispatcher area for 8 free locations in which to create two new direct transfer traces. This search begins at octal location 3540 in WW6.4 or 4470 in WW7.2 and continues until octal location 3740 in WW6.4 or 4670 in WW7.2. If 8 words of free space are not found, an N7 abort will occur. In this case, the user should examine the patch deck and a listing of the patches on the total edit tape to see if a large number of patches have been made to the dispatcher. If this is the case, the dispatcher code will need to be reassembled in order to remove these patches or else the Monitor will not be able to be utilized. The user does have another alternative. This alternative involves patching word 0 of the dispatcher in order to generate a user patch area. The patch involves the setting of bit 2 to a 1 in word 0 of the dispatcher. No other modification by the user is necessary. In this case, GMC will search the dispatcher from octal location 4150 in WW6.4 or 5300 in WW7.2 through octal location 4300 in WW6.4 or 5430 in WW7.2 after checking word 0 to insure that bit 2 has been set.

The MSM collects sufficient information so as to be able to completely monitor the usage of the entire disk subsystem, the usage of SSA Cache core and the usage of FMS catalog cache, when active. When either the MSM or CM is active, a record containing device names and addresses is written at the beginning of the GMC run and periodically afterward if device names change. This is done only for mass store devices. Every time the system issues a connect request to a tape drive or disk drive, sufficient information is collected so as to be able to identify who is issuing the connect, the file being connected to, the pack upon which the file is located, the parameter types for the file being connected to and the reason for the connect, i.e read, write, write verify, etc.

Whenever a MME is issued the MSM will check whether it is a system job issuing a MME GEFSYE. For purposes of this check a system job is considered to be any job with a program number less then octal 15. If the Peripheral Allocator is issuing the GEFSYE, information is collected as to the SNUMB the Peripheral Allocator is working for, and the file code that is being GEFSYE'd. If the GEFSYE type is a 2, 3, 4, 5, 8, 9, 10, 11, 18, 19, 20, 22, 23, 27, 28, or a 29 then additional information is collected so as to be able to determine the CAT/FILE string of the file being GEFSYE'd. This information will be used by the data reduction program to correlate file codes used by jobs to the actual CAT/FILE string being referenced by a job. Also, sufficient information is collected so as to be able to report how many FILSYS connects are required in order for the system to be able to allocate and deallocate files requested by a job.

If FMS catalog cache is active then the MSM will generate a record type octal 77 with sufficient data as to be able to monitor the effect of FMS catalog cache. This record is generated once, for every 5000 connects issued by the system. This is not a physical trace that is being generated and, as such, does not need to be present on the $ TRACE card. Rather, it is merely a data record that is being written to tape and given the unique number of octal 77. The data record consists of a dump of some internal performance parameters maintained by the GCOS system.

5.2.3 CPU Monitor. The CPU Monitor (CPUM) is used to collect data on CPU utilization. For a detailed description of reports containing data collected by this monitor, see section 11. When the user desires that the CPUM be active, GCOS trace types (octal) 10, 11 and 21 must be enabled in the computer system boot deck on the $ TRACE card. CPUM processes trace types 10, 11, 21, and 70 to build its records which are passed to ER. A separate discussion of the format of the CPUM collected data records is contained in subsection 5.4.4. Trace type 70 is a direct transfer trace, created by the GMC, and as such, need not be defined on the $ TRACE card. The CPUM requires that at least the following segment numbers from table 5-3 be used to generate the GMC R* file: 1, 4, 11, 13, 15, 16, 19, 20, 23, and 28. The complete process for generating an R* file is described in subsection 5.6. The CPU Monitor searches the dispatcher for an ASA .SALT,5 instruction and then inserts code to generate a direct transfer trace into GMC. In order to capture subdispatch processor time, it also searches for a STQ .QTOD,4 instruction and then inserts code to make a direct transfer into GMC. In the T70 capture routine, the time increment will be negative for a regular dispatch and positive for a subdispatch. The subdispatch processing is done only when under a WW7.2 release.

The search for the ASA .SALT,5 ranges between octal locations 1500 and 1700 in WW5.4 or 2300-2340 in WW7.2 within the dispatcher. The search for the STQ .QTOD,4 instruction ranges between octal locations 2340

and 2400. If GMC cannot find the ASA .SALT,5 instruction, it will abort with an N1 abort; if it cannot find the STQ instruction it will abort with an N8 abort. If either abort occurs, the dispatcher code should be examined to determine if either instruction has been modified, moved, or patched. If so, the code in GMC will need to be modified.

Upon finding these instructions, GMC searches the dispatcher patch area(s) for four free locations under WW6.4 or eight free locations under WW7.2 in which to create a direct transfer trace into the GMC. This search has the same ranges as that for SSA cache in MSM. If patch space is not found, an N2 abort will occur. See subsection 5.2.2 for user alternatives should this abort occur.

The CPU Monitor tracks the CPU usage of all system programs and accumulates CPU usage of slave jobs into a single value (see subsection 5.4.4). If the user desires, he can specify up to three slave jobs for which he wants the CPU monitor to track CPU usage, just as it does for system jobs. Subsection 5.5.5. describes this user option.

5.2.4 Tape Monitor. The Tape Monitor (TM) is used to collect utilization statistics on magnetic tape drive activity. A separate discussion of the format of the TM collected data records is contained in subsection 5.4.5. Reports containing data collected by this monitor are described in section 11.

When the user desires that the TM be active, GCOS trace types (octal) 50, 51, and 52 should be enabled in the computer system boot deck on the $ TRACE card. TM processes these trace types to build its records which are passed to the ER. The TM requires that at least the following segment numbers from table 5-3 be used to generate the GMC R* file: 1, 7, 11, 19, 23, and 29. The complete process for generating an R* file is described in subsection 5.6.

5.2.5 Channel Monitor. The Channel Monitor (CM) is used to measure I/O channel activity over tape and disk channels and contention to disk devices. A separate discussion of the format of the CM collected data records is contained in subsection 5.4.6. See section 8 for a description of reports containing data collected by this monitor.

When CM is active, it is essential that GCOS trace types (octal) 4, 7, 15, and 22 are enabled in the computer system boot deck on the $ TRACE card. CM processes these trace types to build its records, which are passed to the ER. The CM requires that at least the following segment numbers from table 5-3 be used to generate the GMC R* file : 1, 6, 11, 19, 23, 31, 32, and 33. The complete process for generating an R* file is described in subsection 5.6.

Actually, when the CM is active, sufficient data is processed for obtaining reports not only from the Channel Monitor but also from the Mass Store Monitor. The only Mass Store Monitor data that cannot be

AD-A116 898 COMMAND AND CONTROL TECHNICAL CENTER WASHINGTON DC F/G 17/2
GENERALIZED MONITORING FACILITY. USERS MANUAL.(U)
MAY 82 B WALLACK, G H GERO
UNCLASSIFIED CSM-UM-246-82 NL

2 OF 6
AD A
116898

and 2400. If GMC cannot find the ASA .SALT,5 instruction, it will abort with an N1 abort; if it cannot find the STQ instruction it will abort with an N8 abort. If either abort occurs, the dispatcher code should be examined to determine if either instruction has been modified, moved, or patched. If so, the code in GMC will need to be modified.

Upon finding these instructions, GMC searches the dispatcher patch area(s) for four free locations under WW6.4 or eight free locations under WW7.2 in which to create a direct transfer trace into the GMC. This search has the same ranges as that for SSA cache in MSM. If patch space is not found, an N2 abort will occur. See subsection 5.2.2 for user alternatives should this abort occur.

The CPU Monitor tracks the CPU usage of all system programs and accumulates CPU usage of slave jobs into a single value (see subsection 5.4.4). If the user desires, he can specify up to three slave jobs for which he wants the CPU monitor to track CPU usage, just as it does for system jobs. Subsection 5.5.5. describes this user option.

5.2.4 Tape Monitor. The Tape Monitor (TM) is used to collect utilization statistics on magnetic tape drive activity. A separate discussion of the format of the TM collected data records is contained in subsection 5.4.5. Reports containing data collected by this monitor are described in section 11.

When the user desires that the TM be active, GCOS trace types (octal) 50, 51, and 52 should be enabled in the computer system boot deck on the $ TRACE card. TM processes these trace types to build its records which are passed to the ER. The TM requires that at least the following segment numbers from table 5-3 be used to generate the GMC R* file: 1, 7, 11, 19, 23, and 29. The complete process for generating an R* file is described in subsection 5.6.

5.2.5 Channel Monitor. The Channel Monitor (CM) is used to measure I/O channel activity over tape and disk channels and contention to disk devices. A separate discussion of the format of the CM collected data records is contained in subsection 5.4.6. See section 8 for a description of reports containing data collected by this monitor.

When CM is active, it is essential that GCOS trace types (octal) 4, 7, 15, and 22 are enabled in the computer system boot deck on the $ TRACE card. CM processes these trace types to build its records, which are passed to the ER. The CM requires that at least the following segment numbers from table 5-3 be used to generate the GMC R* file : 1, 6, 11, 19, 23, 31, 32, and 33. The complete process for generating an R* file is described in subsection 5.6.

Actually, when the CM is active, sufficient data is processed for obtaining reports not only from the Channel Monitor but also from the Mass Store Monitor. The only Mass Store Monitor data that cannot be

collected would be the data needed to analyze Cache Memory. If the user also wants this data to be collected, he should create an R* file from the following segments (see table 5-3): 1, 3, 6, 11, 14, 15, 18, 19, 22, 23, 31, 32, and 33. In addition, the Mass Store Monitor must be made active. There is an additional option available with the Channel Monitor. This option allows the Channel Monitor Data Reduction Program to produce a CPU Idle/IO Active Report. This report is described in section 8. To obtain this report, the Idle Monitor must be included in the R* file. In addition, all Idle Monitor traces must be active. The following segments are required to generate the R* file: 1, 6, 10, 11, 19, 23, 24, 25, 31, 32, and 33.

5.2.6 Communications Analysis Monitor. The Communications Analysis Monitor (CAM) is used to measure machine and user response time and terminal usage. *A separate discussion of the format of the CAM* collected data records is contained in subsection 5.4.7. The complete process for generating an R* file is described in subsection 5.6. The output reports, containing data collected by CAM, are described in section 9. When CAM is active, it is essential that the GMC generated trace type (octal) 14 is enabled in the computer system boot deck on the $ TRACE card. CAM patches the DNWW/MDNET in W7.2) module, looking for a LDQ M.LID,3 instruction [illegible] lowed by an ANQ =0077777,DU instruction. When the monitor is ter[illegible]ed, CAM removes these patches from the system. The CAM [illegible] hat at least the following segment numbers from table 5 [illegible] erate the GMC R* file: 1, 5, 11, 12, 15, [illegible], 19 [illegible]

The method used by the CAM [illegible] similar to that used by the CPUM to patch the [illegible] hes DNWW/MDNET for the LDQ M.LID,3 instruct[illegible] cation 5000 and ending at octal location 6000 [illegible] find this instruction, GMC will abort with an N3 abort [illegible] problem occurs, the DNWW/MDNET code should be examined to [illegible] if this instruction has been moved out of the octal range 5000-6000 due to an edit or recompile. If so, the code in CAM.PAT will need to be altered.

Upon finding this instruction, CAM then searches DNWW/MDNET patch area for 10 free locations in which to create a new system trace type 14. This search begins at octal location 11020 and continues for 140 octal locations. If 10 free words of space are not found, then seven words of patch space are searched for within the dispatcher. This search occurs between octal locations 3540-3740 in W6.4 or 4470-4670 in W7.2. If no space is found by either of these searches an N4 abort will occur. In this case, the user should examine the patch deck to see if a large number of patches have been made to DNWW/MDNET. If this is the case, DNWW/MDNET will need to be re-edited in order to remove these patches or else the CAM will not be able to utilized. If a specific terminal's traffic is to be monitored (see subsection 5.5.3), the CAM will insure that no more than two terminal IDs have

been included. Invalid terminal IDs, extra terminal IDs or terminal IDs without the CAM input option request will cause the GMC to abort with a CD, CO, or ET abort. See table 5-2 for the meaning of these aborts.

5.2.7 GRTS Monitor. The purpose of the GRTS Monitor (GRTM) is to collect statistical data to be used in evaluating the performance of the DATANET 355 Front-End Processor (FEP). This data includes CPU Utilization, Response Time, and Terminal Performance. The collected information is sent to the GMC within the H6000, which writes the data to tape. A separate discussion of the format of the GRTM collected data records is contained in subsection 5.4.8. This tape, containing GRTM performance data and possibly data from other monitors, is used as input to a data reduction program used to produce statistical reports. (See section 10).

5.2.7.1 Configuration Requirements. The GRTM will execute on H6000 system with up to eight FEPs. The monitor is designed to run on the GRTS II Phase IIA (GRTS 1.2) FEP software.

5.2.7.2 H6000 Configuration Requirements. To run GRTM, GCOS trace type (octal) 62 must be enabled via the H6000 computer system boot deck on the $ TRACE card. The GRTM requires that at least the following segment numbers from table 5-3 be used to generate the GMC R* file: 1, 8, 11, 19, 23, 34, and 35. The complete process for generating an R* file is described in subsection 5.6.

5.2.7.3 Altering of Phase II-A Software. To use the GRTM, the user must modify the standard GRTS software by applying a set of alters supplied with release of the GMC software. It should be noted that in Release WW7.2 the alter cards to support the monitor may be included within the standard release. If this is the case then only the following procedures need to be followed. The user must check the FMAC module to insure that variable FMON has been set to 1. The FMAC module must be recompiled and the macro library reloaded. Finally, all the GRTS modules should be recompiled. The user should check the release bulletin to confirm whether the required alters have been included within the standard release. Upon completing this procedure the user should refer to subsection 5.2.7.4. If an old GRTS release is being edited, the user should execute the following procedure.

Files needed in order to assemble the GRTS modules are contained under catalog B29IDPXO/GMFCOL/GRT/ALTER. The object decks created from the reassembly of the GRTS modules are contained under catalog B29IDPXO/GMFCOL/GRT/OBJECT. Both subcatalogs are included on the GMF save tape. (See figure 5-2.)

B29IDPXO

GMFCOL

MAK.XXX	GMF.OBJ	PATLOOK	GMF	MUM	MSM	CM	CPU	TM
			GMF.TOP	MUM.INIT	MSM.INIT	CM.INIT	CPU.INIT	TM.INIT
			GMF.BTM	MUM.T10	MSM.PAT	CM.T04A	CPU.PAT	TM.T50
			GMF.MID	MUM.T46	MSM.REMO	CM.T22A	CPU.T70	
			GMF.MON		MSMDOIT	CM.T07A	CPU.REMO	
							CPUDOIT	

Figure 5-2. GMC Catalog File Structure (Part 1 of 2)

B291DPX0
GMFCOL (Continued)

CAM	GRT	ALTER	OBJECT	IDLE	TPE
CAM.INIT	GRT.INIT	INSTALL	CCP	IDL.INIT	TP.INIT
CAM.REMO	GRT.T62	CCPALT	EXC	IDL.TRCS	TPE200
CAM.PAT	GRT.COL	EXCALT	CIP	IDL.T21	
CAM.T14	ALTER	CIPALT	INIT		
CAMDOIT	OBJECT	INTALT	ICM		
		ICMALT	SUB		
		SUBALT	HCB		
		HCBALT			

Figure 5-2. (Part 2 of 2)

The procedures for installing the GRTS-II modules needed by the data collector is as follows:

a. Install GRTS-II Phase IIA from the IMCV tape included in the system release tapes.

b. Do a series of RUNS of file B29IDPXO/GMFCOL/GRT/ALTER/INSTALL to submit jobs which reassemble the GRTS modules.

c. Create new spawn files which reference the newly created GRTS object files and which contain, in the GRTS configuration cards, the card "$ GOPT RCSMON."

The JCL skeleton for reassembling a GRTS-II module is as follows:

```
10##N
20$:IDENT:PWIN,INST-GRTS
30$:PROGRAM:SALT,ON5,NGMAC,DECK,LSTOU
40$:LIMITS:10,65K,,20K
50$:PRMFL:C*,W,S,B29IDPXO/GMFCOL/GRT/OBJECT/XXX
60$:PRMFL:**,R,R,GRTSII/FASTMAC
70$:PRMFL:M*,R,S,GRTSII/S.GRTSII
80$:DATA:I*,,COPY
90$:SELECTA:GRTSII/ALT/FXXX
100$:SELECTA:B29IDPXO/GMFCOL/GRT/ALTER/XXXALT
110$:ENDCOPY
120$:ENDJOB
```

The file (/ALTER/INSTALL) may need to be edited if the IDENT information needs to be changed or if the GRTS-II files are installed under a userid other than GRTSII. The installation IMCV tape creates catalog GRTSII/ALT, which contains alters to each of the GRTS-II modules. The skeleton JCL stream concatenates the alters necessary to run the GRTS-II monitor to these standard alters. The following will submit jobs which reassemble the GRTS modules:

```
EDIT OLD B29IDPXO/GMFCOL/GRT/ALTER/INSTALL,R
RS:/XXX/;*:/CCP/
RUN
OLD INSTALL
RS:/XXX/;*:/EXC/
RUN
OLD INSTALL
RS:/XXX/;*:/CIP/
RUN
OLD INSTALL
RS:/XXX/;*:/INT/
RUN
```

```
OLD INSTALL
RS:/XXX/;*:/ICM/
RUN
OLD INSTALL
RS:/XXX/;*:/SUB/
RUN
OLD INSTALL
RS:/XXX/;*:/HCB/
RUN
DONE
```

The following JCL is typical of a GRTS-II spawn file:

```
$       LOWLOAD
$       OPTION  NOSETU,NOFCB
$       SELECT  GRTSII/FDBL
$       SELECT  GRTSII/FDLD
$       EXECUTE DUMP,ON5
            GRTSII
$       LIMITS  20,26K,,10K
$       SYSOUT  LP
$       PRIVITY
$       DATA    CR,,COPY
$       OPTION  SYMREF
$       ENTRY   FINT
$       SELECTD GRTSII/OBJ/CCP
        (configuration cards)
$       SELECTD GRTSII/OBJ/EXC
$       SELECTD GRTSII/OBJ/TTY
$       SELECTD GRTSII/OBJ/LSA
$       SELECTD GRTSII/OBJ/VIP
$       SELECTD GRTSII/OBJ/HDL
$       SELECTD GRTSII/OBJ/PWI
$       SELECTD GRTSII/OBJ/PLA
$       SELECTD GRTSII/OBJ/RCI
$       SELECTD GRTSII/OBJ/RNP
$       SELECTD GRTSII/OBJ/RLP
$       SELECTD GRTSII/OBJ/HNP
$       SELECTD GRTSII/OBJ/CLT
$       SELECTD GRTSII/OBJ/TCP
$       SELECTD GRTSII/OBJ/HCB
$       SELECTD GRTSII/OBJ/CIP
$       SELECTD GRTSII/OBJ/SUB
$       SELECTD GRTSII/OBJ/TBL
$       SELECTD GRTSII/OBJ/ICM
$       SELECTD GRTSII/OBJ/INT
$       ENDCOPY
***EOF
```

(This is the sample JCL file contained on the GRTS-II installation IMCV tape.)

Such a file must be edited to replace the references to GRTSII/OBJ/CCP, /EXC, /CIP, /SUB, /ICM, /HCB, and /INT by B29IDPXO/GMFCOL/GRT/OBJECT/CCP, /EXC, /CIP, /SUB, /ICM, /HCB, and /INT.

5.2.7.4 <u>FEP Configuration Requirements.</u> The modified GRTS II software <u>will produce performance data.</u> These modifications are then enabled in the software through the use of the following control card during FEP system initialization:

CC1

```
1       8       16
$       GOPT    RCSMON
```

When the monitor is not running, the FEP will function normally. Execution of the GRTM is initiated by the H6000 as it connects to each FEP to be monitored. At that time, instructional parameters are sent to each FEP to be used in determining the amount of buffer space needed for the collection of the statistical data.

The GRTM software when configured will require an additional 1,000 (decimal) words of DATANET main memory to execute. This core requirement can grow to as much as 2,500 decimal words depending upon the input options selected. The main portion of the monitor code will be resident within the GRTS II FSUB module with additional patches being incorporated within the FCCP, FEXC, FCIP, FINT, FICM, and FHCB modules. It should be noted that when the monitor is not assembled, the 1-2K of core required for the monitor will be available for buffer space. This should be kept in mind when reviewing the output reports.

5.2.7.5 <u>Interface Requirements.</u> During its initialization phase, the GRTM software <u>will attempt to log</u> onto the H6000 system via a pseudo-terminal that is used in its interaction with the host-resident GMC program. Due to .MSECR requirements, the pseudoterminal attempting to gain access to the system must be on a .MSECR configured SYSTEM HSLA subchannel. The Physical Terminal Address (PTA) used by the pseudo terminal is unique and therefore cannot be configured in the GRTS II configuration deck for any other purpose.

The format of this PTA word is as follows:

BITS	MEANING
0-3	IOM CHANNEL NUMBER OF HSLA
4-5	HSLA NUMBER (1,2,3)
6-10	HSLA SUBCHANNEL NUMBER (0-31)
11-15	POLLED SCREEN NUMBER
16-17	MUST BE ZERO

As an example, a PTA value of 317200 would be used to identify the pseudo terminal as being on:

```
IOM CHANNEL NUMBER OF HSLA = 6
HSLA NUMBER                = 1
HSLA SUBCHANNEL            = 29
POLLED SCREEN NUMBER       = 0
MUST BE ZERO
```

This is the same format used to describe subchannels within .MSECR.

A user must insure the setting of the PTA value as circumstances demand. By using the format shown above, the symbolic location PTA located in the file B29IDPXO/GMFCOL/GRT/ALTER/SUBALT may be altered to reflect the user's own PTA value. The FSUB module must then be reassembled prior to bootloading the DATANET.

5.2.7.6 Abort Codes. The general abort codes listed in table 5-2 apply to specific options. Abort codes created specifically for the GRTM are listed below.

GS = SSA processing error caused by missing or invalid $LIMITS card

GC = Invalid GRTM options on data card file (I*)

GC = Missing GRTM option card

GD = No FEP I/O can be performed

GM = GEMORE unsuccessful in getting needed buffers

NOTE: GM aborts occur if another program occupies continuous memory just above that of the GRTM when buffer space is requested using MME GEMORE. Increasing the $LIMITS memory value or loading the GRTM immediately after booting the system will enhance the chances of getting DATANET buffers.

5.2.7.7 DATANET Monitor Software Description. The GRTS II system operating within the DATANET will be used in the collection and recording of various internal resource information which is then sent to the GMC executing in the host (6000) system. Monitoring functions within the DATANET have been separated into three basic monitoring categories:

a. CPU and Resource Monitoring

b. Host/FEP Response Time

c. HSLA Subchannel Monitoring

Monitor information will be passed between the DATANET and the GMC program executing in the host using the normal FICM interface.

5.2.7.7.1 DATANET-HOST Interface. The GRTM executing in the DATANET will be in the form of a pseudoterminal connected to the DATANET. Once initialized, the pseudomonitor terminal will be as any other remote terminal connected to a Direct Access (DAC) program in the host.

As part of GRTM initialization, the pseudo terminal will issue a connect-to-slave request to the DAC GMC program in the host. The DAC connect name requested will be the special monitor name of GRTMN'X' with the 'X' being a number from zero through seven which corresponds to the DATANET (0-7) that issues the connect request.

The connect-to-slave request will remain outstanding until it is answered by an inquiry issued by the GMC program. Once the request has been answered, the GRTM/GMC program connection will be made.

Since the pseudo monitor terminal will not be physically connected to the DATANET (i.e., on an HSLA S/C) the need for a special monitor "Terminal Control Block (TCB)" becomes necessary.

The special monitor TCB is necessary in order to utilize the normal FICM interface in the passing of monitor information to the GMC program.

5.2.7.7.2 Monitoring of CPU. The DATANET Monitor will collect CPU and various resource information by the placement of conditionally assembled instructions at appropriate points in the ICM and EXC modules of the GRTS II software. The information to be collected at the CPU level is independent of the HSLA subchannel and is sent to the host based upon a predefined time sampling increment for writing buffers to the host collector program. For a given buffer sent to the host, the following information is included:

a. Time Idle - The amount of time in milliseconds spent in the exec idle loop since the last buffer was sent to the host.

b. Buffer Denials - A cumulative count of buffer denials. This is a count of the number of times that the GRTS II software was unable to get a buffer for a user.

c. Buffer Availability - The number of 18-bit words currently available for buffers.

d. Number of Users - Count of the number of users currently logged on the system.

e. Number of Transactions - Two counts are maintained and sent to the host:

(1) The accumulated number of transactions sent to the host, and

(2) The accumulated number of transactions received from the host.

f. Size of Transactions - There are two counts maintained and sent to the host:

(1) A cumulative count of the number of 36-bit word sent to the host, and

(2) A cumulative count of the number 36-bit words received from the host.

g. Host RSVPs Count - A cumulative count of the number of host RSVPs received by the DATANET.

h. Buffer Requests - A cumulative count of the number of times the buffer allocation routine was called.

5.2.7.7.3 Host/DATANET Response Time. The GRTS II Monitoring of the FEP/Host Response Time will be measured on a program name basis. For this monitoring, conditional coding will be added to the FICM module to detect the various requests to the Host. Each time that either a "Connect-to-Slave" or "Disconnect" request is detected, the following formatted entry will be made into the response time buffer area:

a. Function Code

b. Type of Device/Line ID

c. Time Stamp

d. DAC Name (for connect-to-slave requests only)

The Function Code (i.e., connect-to-slave, disconnect) will identify the type of request with the line number entry identifying the logical line number of the device.

The GRTM will capture the following requests:

a. Accept Direct Input (355 asking H6000 to accept data)

b. Input Accepted (input received by the H6000)

c. Send Output (355 requesting continuation of output)

d. Output Received (355 has received data from H6000)

e. Output Started (355 has begun transmitting data to terminal)

f. Output Complete (355 has completed transmission of data to terminal)

g. Accept Direct Output (H6000 has told 355 it has data to send)

h. Accept Direct Output, Then Input (H6000 has told the 355 it has data to send and expects input)

Each time one of the above requests or responses is detected, a response time buffer entry of the following format is made:

a. Function Code

b. Type of Device/Line ID

c. Time Stamp

In placing both the line number and the time stamp in every collector buffer entry, response times between the various request cycles of each DAC program executing the host will be effectively monitored.

5.2.7.7.4 Terminal Monitoring. GRTS II Terminal Monitoring will be on a HSLA subchannel (S/C) basis. Every monitored HSLA S/C will be allocated a four word (18 bit) record area within the output buffer where the various monitor information for the S/C is accumulated. Each word within the S/Cs record will be a "predefined" location where the various counts for the S/C are held. The first word of each S/C record will contain information as to the HSLA number and the S/C number to which the record belongs.

The GRTM will update these various counts dynamically as they occur within the DATANET.

5.2.8 Idle Monitor. The Idle Monitor (IDLEM) is used to collect data concerning CPU activity. This monitor can only be used in conjunction with the MUM or the CM. It should not be activated if one of the two aforementioned monitors is not active. If the Idle Monitor is present on the R* file and active and if, in addition, the MUM or CM is not active, then the IDLEM will automatically be turned off. The user should read subsections 5.2.1 and 5.2.5 for information concerning the use of the IDLEM. A separate discussion of the format of the collected data records is contained in subsection 5.4.9.

5.2.9 Transaction Processing System Monitor. The GMC Transaction Processing System Monitor (TPSM) is used to collect data on the performance of the GCOS Transaction Processing Executive (TPE)

System. A separate discussion of the format of the TPSM collected data records is contained in subsection 5.4.10. The reports containing data collected by TPSM are described in section 12.

When TPSM is active, the required traces must be enabled in the computer system boot deck on the $ TRACE card (see table 5-1). A sample of the reports and run time procedures for the data reduction program can be found in the Transaction Processor System section 12. The TPSM requires that at least the following segment numbers from table 5-3 be used to generate the GMC R* file: 1, 9, 11, 19, 23, and 36. The complete process for generating an R* file is described in subsection 5.6.

5.2.9.1 TPS Trace Collection. The TPSM is unlike most other GMC monitors in that monitoring of the Transaction Processing System is controlled via the operator console. Prior to collecting data, the user must alter the TPS (see subsection 5.2.9.2) and must also create a usable GMC R* file (see subsection 5.6). Once these actions are performed and a GMC execution is started, the user must still perform one additional action before data collection can begin. The TPSM is turned on or off by the console operator via the TP MESS command. The operator must request "TP MESS". When the console responds "TP MESS?", the message "TRACE ON" is entered to start processing traces, or "TRACE OFF" to discontinue trace processing. This procedure can be repeated as often as desired. The TPSM is the only GMC monitor that can be turned on or off while the GMC is physically executing.

5.2.9.2 Modifying the Transaction Processing System. To use the TPSM, the user must alter the Transaction Processing System. An alter file is provided with the GMF software delivery. The file name is B29IDPXO/SOURCE/TPEALT. This file contains all alters and associated JCL necessary to modify the standard TPS. These modifications apply only to the WW7.2 version of TPS. The user will need to make minor modifications to the file so as to correctly reference any permanent files that are required.

5.3 Processing

The GMC requires one tape drive, 15K-24K words of storage, and, if the multireel option will be used, 300 links of disk storage to execute. The actual memory required will depend on the number of monitors selected for execution. The GMC will lock itself into memory, assuring that it cannot be swapped or moved during the run time. An initialization procedure will attempt to relocate GMC out of the memory growth range of Time-Sharing (TS1) and, in addition, relocate GMC to the high or low end of a quadrant of memory. Due to this

feature, GMC can be started at any time of the day, without fear of causing memory fragmentation or degraded TSS response.

Immediately prior to beginning collection of data, GMC will attempt to relocate out of the TSS (TS1) memory growth range. On a system with more than 256K of memory, the growth range of TSS (TS1) is assumed to be 180K, while on a system with less than 256K of memory the growth range is considered to be 100K. During this relocation procedure GMC might grow in size; however, the user need not be concerned, since GMC will release all unneeded memory after the relocation operation is completed. If GMC cannot relocate out of the growth range of TSS (TS1), the GMC will abort with a CM abort. The user can override this abort with a data card option, but he should do so with great care since TSS response might be severely degraded if GMC prevents TSS (TS1) from growing in size. The procedures for overriding the abort can be found in subsection 5.5.4.

After GMC succeeds in relocating out of the growth range of Time-Sharing, GMC will attempt to relocate itself to the high or low end of the memory quadrant. It will relocate as far away as it can, but it will not abort if it is unsuccessful. Therefore, slight memory fragmentation is still possible, but this should cause little if any problem to the operation of the computer.

5.3.1 Executive Routine. The Executive Routine (ER) controls the processing of the GMC. The ER controls all inputs, outputs, start and stop time, and all required error processing. The ER also hooks the GMC into the dispatcher.

The ER begins processing by reading the input parameters on the data card. The procedure for determining the required data card parameters for GMC operation is fully described in subsection 5.5. Using these parameters, ER determines which monitors will be active during the run. If a start time is specified, ER will remain idle until the start time is reached. During this time, it is possible that GMC will be swapped. The ER will cause the GMC to terminate at a specified stop time if the option is present. Multireel output is the standard default for GMC; however, the user can request GMC to terminate after one or more reels of data have been collected. The ER controls all error aborts within GMC. Abort codes and reasons for the abort are shown in table 5-2. When ER begins processing, it will query the operator for the first tape number with the message:

*FOR XXXXX WHAT IS THE MOUNTED TAPE'S NUMBER?

where XXXXX is the SNUMB assigned GMC. The operator must enter the reel number of the tape to be used for GMC output. If the operator

does not reply to the message, the question will be repeated. It is important that all tapes requested by GMC contain a write ring and be mounted as quickly as possible.

The GMC will execute a GEWAKE statement (and may be swapped) if it is not desired immediately (user has requested a time option). When the ER determines that it is time to begin monitoring, it will move the GMC out of the growth range of TSS (TS1). Upon successfully moving GMC, the ER will issue a message to the operator indicating which monitors have been selected for execution. The monitors will be referenced by the mnemonic code shown in table 5-1.

For example if the Mass Store Monitor, Channel Monitor, and Communications Analysis Monitor are active, the following message will be printed:

```
*MONITORS MSM CM CAM
```

If this message does not appear within 5 minutes of the monitoring start time, the GMC has encountered a severe problem in its attempt to move. Such a problem should be a rare occurrence. If this problem does occur, GMC should be termed and restarted.

If the multireel option (see subsection 5.5.2) is specified (i.e., an M9 or M91 does not appear on the GMC data card), the GMC will issue the following message to the operator when it reaches the end of a reel:

```
*FOR XXXXX MOUNT Y REEL ON ZZZZZZ
 FIRST TYPE NEW TAPE # -
```

where XXXXX represents the SNUMB of GMC, Y represents the sequence number of the next data tape, and ZZZZZZ is the tape drive address. Should the operator be distracted for more than 30 seconds, GMC will reissue the message.

Once the operator gives the GMC a tape number, the ER rewinds the data tape and waits one minute for the tape to rewind. The ER then checks the tape status, and if the next tape has not been mounted, the ER issues the message:

```
**AGAIN MOUNT TAPE * XXXXX FOR MONITOR YYYYY ON ZZZZZZ
```

where XXXXX is the reel number, YYYYY is the SNUMB assigned to GMC, and ZZZZZZ is the tape drive address.

This procedure of waiting one minute and reissuing the message is repeated until the tape is mounted. During this timeframe, the ER is writing any full buffers collected to its overflow disk file. Since

this file can fill and cause an abort, the operator should ensure that the data tape is mounted as soon as possible.

After the GMC processes the data card, individual monitor initialization is accomplished. After initialization is completed, the memory used for the initialization code is used for buffering the collected monitor data prior to it being written to tape. GMC is coded for extended memory systems with the exception of nonextended memory. When nonextended memory is sensed, the extended memory instructions throughout the program are changed. If the initialization is accomplished successfully, GMC will "hook" itself into the dispatcher and become an extension of the dispatcher. The normal system trace procedures consist of the following three unique instructions:

```
LDAQ **,7*
STAQ **,2
TRA  0,1
```

The GMC modifies this normal sequence in the case of extended memory. Each trace event will preserve the current MBA value, set the MBA value for the GMC, and transfer to the GMC. The resulting interface includes the following:

```
SMBA  MBASTR,7
LMBA  GMCSMBA,DU
TRA   GMC.
```

The interface is completed by execution of the

```
LDAQ  **,7*
STAQ  **,2
```

in GMC, which completes the normal trace procedures. In a system with nonextended memory, the interface is less complex, resulting in one instruction change in the trace procedures. The

```
LDAQ  **,7*
STAQ  **,2
TRA   0,1    of the trace
```

is altered to look like

```
LDAQ  **,7*
STAQ  **,2
TRA   GMC.
```

Whenever the dispatcher executes a trace after this point, the GMC ER will gain control and pass the system control over to the proper monitor for data collection. Control is then returned to the ER for return to the dispatcher.

In the process of collecting data, a monitor may desire to save a logical record on the collection tape. In order to sequence all logical records to the tape file, a common buffering system has been provided by the GMC. Any monitor can pass control to symbol BUFCTL for buffering a logical record to be saved on the tape file. This code is executed in master mode as an extension of the operating system function where control has been taken. Writing the buffered data to tape is a GMC slave function which requires controls between the buffering system and the writing system. The buffering system indicates, via software to the slave, when an individual buffer is to be written. After the slave has written the buffer, it is returned to the buffering system. The slave code for writing the tape is started at symbol BUFCHK. This slave portion is normally in GEWAKE mode and is awakened either by GMC master mode code or by a normal dispatch. The slave function will check for a full buffer and write it before going back to sleep. This process is repeated until GMC has been terminated, at which time the slave portion will execute the proper abort code via a MME GEBORT. The wrap-up procedure then performs all termination requirements. GMC will terminate via direction from the time option on the data card, limited reel option on the data card or else via console command. If no time option or limited reel option has been selected, the GMC will continue to process until it is ABORTED via the console.

At termination, the wrap-up location is given control and the termination record is processed. This is the slave termination of GMC. Also associated with termination is the return of the dispatcher code to its original state. This is accomplished by GMC checking its own .STATE word for a termination code. When the termination code is sensed, the dispatcher hook is removed, the original code is replaced, and the slave termination process is completed. Upon termination, ER reads the communication region table, writes the data to tape with a termination record, removes any patches it has placed in the system, and proceeds to wrap up.

5.3.2 Output. Output of GMC is always a magnetic tape file. The following is a guideline for the number of tapes generated by each monitor (800 BPI, 2400 feet tape reels):

MUM - one tape every 6-8 hours. With Idle Monitor, one tape every 3 hours.
MSM - one tape every hour

CPUM - 1 tape every 24 hours
TM - 1 tape every 24 hours
CM - 1 tape every half hour
TPSM - 1 tape every four hours
CAM - 1 tape every eight hours
GRTM - 1 tape every 24 hours

Analysis of this tape(s) is accomplished by a series of dedicated data reduction programs which are discussed in sections 6 through 12. It is essential that the proper data reduction program is run against data created by its associated monitor routine.

The GMC is usually terminated by operator request. However, there are times when the monitor may terminate itself. In most of these cases, the operator will receive a console message indicating the reason for the abort (see table 5-2). However, under some circumstances the message the operator sees is that GMC terminated with "NO REASON SPECIFIED." In this case, if the job listing is examined, a reason will be given under the WRAPUP activity information as shown below.

```
* ACTY-01 $ CARD #0008* GELOAD  03/16/78  SW=000000000000
NO REASON SPECIFIED         AT 030440 I=5060 SW=000000000000

*WRAPUP BEGUN
(USERS BS MME GEBORT)       AT 031413 I=0000 SW=000000000000
```

5.4 GMC Data Records

5.4.1 GMC Executive. The GMC Executive produces an initialization record that must be read by every data reduction program. This record contains information on the system configuration and the status of various queues at the time the monitor started. The length of the record is dependent on the size of the configuration. The Executive also writes a termination record whenever it terminates normally.

Initialization Record

Word	Bits	Information
1	0-35	Block Control
2	0-35	Zero
3	0-17	Year (.CRJCD)
	18-35	Julian day (.CRJCD)
4	Not used	
5	0-35	Current date (.CRDAT)
6	0-35	Current time (.CRTOD)
7	0-35	Reg A of RSCR 32

8	0-35	Reg Q of RSCR 32
9	0-35	Software release (.CRSR)
10	0-17	Size of HCM (.CRHCL)
	18-35	Not used
11	0-35	I/O Channel limits (.CRICL)
12	0-35	Hardware IOM type .CRIOC
13	0-17	Not used
	18-35	Memory size (.CRMSZ)
14	0-17	Tape sieve parameter (.CRMTP)
	18-35	Link sieve parameter (.CRMTP)
15	0-17	Number of IOM's configured (.CRNIC)
	18-35	Length of system file table (2 words per file)
16	0-17	Number of processors configured (.CRNPC)
	18-35	Shared System Number (.CRSSN) This value applicable only if bit 2 in word 19 is set.
17	0-35	CPU type (RSW 2 instruction)
18	0-35	BCD System ID (.CRSID)
19	0-35	System configuration (.CRFIG)
20	0-17	1st user program number (15 for WWMCCS, set by FSTSLV)
	18-35	first program number for GEIN (64 - number of card readers)
21	0-35	GMF LAL and full size (.SALIM+1)
22	0-17	GMF program number
	18-35	Zero
23	0-35	Idle time for processor 0 (.CRIDT)
24	0-35	Overhead time for processor 0 (above 2 words are repeated for each configured processor (word 16 bits 0-17))
25+	0-17	SCT address for system file 1
	18-23	Device type for system file 1
	24-29	Device number for system file 1
	30-35	Not used
26+	0-17	Starting llink number on device for system file 1
	18-35	Length of system file 1 in llinks (word 25+ and 26+ are repeated for each system file. Total number of words for this portion of record is found in word 15 bits 18-35.)
27+	0-35	Module directory (MDD) table address and length (.CRMDD)
28+	0-35	GECALL name (GMD) table address and length (.CRGMD)
29+		MDD table-one word per entry, plus one extra word if length is odd

30+		GMD table-one word per entry, plus one extra word if length is odd
31+	0-35	SCT table address (.CRSCT)
32+	0-17	Number of devices described below
	18-35	Not used
33+	0-35	SCT information for each channel on each IOM. Since both MTS0600 and MTS0610 tape drives have the same device type, bit 25 in the corresponding .CRCT1 word is used. If this bit is set, then 610 tape drives are indicated by device types 03 and 04 for 7- and 9-track tape drives. The length of this portion of the initialization record is 48 times the number of IOM's configured (word 15 bits 0-17) plus the contents of word (32+) bits 0-17.
34+	0-35	GMF tape number
35+	0-35	Monitors active indicator - Bit i set corresponds to monitor i active

Following the GMC initialization record is a special record describing the CPU configuration, channel availability, and memory utilization. Depending on the monitors selected for execution and on the particular GCOS trace which first passes through the dispatcher "hook," a few traces may precede this record (e.g. during their initialization routines, the mass storage, channel, communications, and GRTS monitors write records). During the execution of GMC, this record is written again every five minutes. This is done in order to capture any releasing or assigning of memory that may have occurred. Since this record is generated every five minutes, it is possible that the correct memory configuration will not be available to the data reduction program for at most a 5-minute period of time. This will result in only a minor distortion of reports and will prove insignificant. If a central processing unit is dropped or added, the collector will recognize this fact immediately and generate this reconfiguration record immediately. If a channel or IOM is dropped or added, this will be reported by the reconfiguration record that is generated every five minutes. It should be noted that if multiple changes occur within a 5-minute period, only the final change will be reported.

The following communication region cells are constantly monitored for changes, since a processor reconfiguration may generate numerous traces while it is being performed:

1. .CRNPC - Lower half specifies number of processors released

2. .CRXPC - Upper specifies processor dedicated to T&D

3. .CRCMC - Six-word processor assignment table maps logical processor number to a physical port on the SCU; table is also updated if a program sets its .STATE word to force execution on a specific processor.

4. .CRMDB - Specifies information about SSA cache; may change during a memory release operation.

Because of the number of events involved in reconfiguration, multiple records may be written for the same reconfiguration. System programs (e.g. T&D) may cause a record to be written if they withdraw a processor from normal dispatching. They may also be written if a program sets its .STATE word to restrict it to or from a specific processor. Such a program must also update a counter within the .CRCMC table.

The format of the reconfiguration record is as follows:

Word	Bits	Information
1	0-17	Number of words following (record control word - RCW)
	18-35	Octal 500100 (Special record)
2	0-35	RSCR time
3*	0-17	Number of processors configured (.CRNPC)
	18-35	Number of processor released
4*	0-17	Processor dedicated to T&D (.CRXPC)
	18-35	Reconfiguration Flag
5-10	0-35	Processor assignments (.CRCMC)
11	0-17	MBA of SSA cache (.CRMBA) (zero if non-extended memory)
	18-35	Not used
12	0-17	LAL of SSA cache (.CRMDB)
	18-29	Size of SSA cache (# of buffers)
	30-35	Not used
13*	0-8	Option word in .MFSIO
	9-17	Number of 320-word buffers for catalog cache
	18-35	Not used
14*	0-17	MBA of catalog cache (entry point -9 of .MFSIO) (zero if nonextended memory)
	18-35	Absolute address of catalog cache

15	0	Flag (=1 - Record written after 100 .EXIT traces processed without match on triggering .CALL trace)
	1-17	Code for event triggering this record 1 Initialization record 2 5 minute record 10 Change in .CRNPC or .CRXPC (Not monitored in WW6.4)* 11 Change in SSA cache (.CRMBA or .CRMDB) If a RLSEC request references the SSA cache buffer, then two reconfiguration records may be generated: one for deallocation of SSA cache (.CRMDB) and a second for the actual memory release (update of .CRPMU memory map). A further reconfiguration record will be generated if the SSA cache buffer is relocated. 12 Change in processor assignments (.CRCMC) 13 Change in FMS options or catalog cache (Not monitored in WW6.4)*
	18-35	Number of words following for channel information, one word per configured channel (.CRCT1)
16+	0-35	.CRCT1
17+	0-35	Memory map (.CRPMU)

The length of this part of the special record is equal to the length contained in the RCW minus 14 minus the contents of bits 18-35 of word 15.

*This data is reported as zeros in WW6.4.

When GMC terminates, it writes a record containing information read from communication region cells and information about the amount of processor time used by the GMC collector in processing traces and also by the slave portion of GMC in performing its initialization and tape I/O. The format of the complete termination record is as follows.

Termination Record

Word	Bits	Infomation
1	0-17	Size of record (=23)
	18-35	Octal 300100

2	0-35	Memory size .CRMSZ
3	0-17	Number of IOM's (.CRNIC)
	18-35	Not used
4	0-17	Number of processors (.CRNPC)
	18-35	Not used
5	0-35	Current date (.CRDAT)
6	0-35	Current time (.CRTOD)
7	0-35	System configuration .CRFIG
8	0-35	Monitor slave processor time
9	0-35	A register from RSCR 32
10	0-35	Q register from RSCR 32
11	0-35	Idle time processor 0
12	0-35	Overhead time for processor 0 (words 11 and 12 are repeated for each configured processor)
13+	0-35	Number of times through GMC
14+	0-35	CPU time in GMC executive
15-25+	0-35	CPU time in MUM, MSM, CPUM, TAPE, CM, CAM, GRTM, TPE, IDLEM, NAME, FMS GEFSY
26+		Not Used

5.4.2 MUM. The MUM processes GCOS system trace types 10, 11, 46 and 51 by creating its own data collection records to describe the effect of these system events.

5.4.2.1 Trace Type 10. This MUM generated record contains sufficient information to describe the status of every job known to the Peripheral Allocator and Core Allocator. Each job is described in program number sequence. The format of a trace type 10 GMC data record is shown below. The data in this record is obtained from the occurrence of a system trace 10, 11 or 51 event.

Word	Bits	Information
1	0-17	Number of words following (record control word)
	18-26	Not used
	27-35	Octal 10 (trace number)
2	0-17	# (N) of 3 word entries in PALC data - if both bits 24 and 25 are set to 1
	18-23	not used
	24,25	If both set to 1, PALC record exists as described below - else PALC data not present
	26-35	not used

3-(3*N+2)	0-35	SNUMB
	0-11	Program status
	12-17	Program #
	18-26	Memory needed
	27-28	Not used
	29-35	Activity #
	0-5	Device type needed
	6	0 = fixed device 1 = removable device
	7-17	# of devices needed
	18-35	Not used

The following occur after the PALC data or after word 1 if there is no PALC data (bits 24 or 25 set to 0). This information is variable with 1 or more words per program. When no PALC data exists, word 2 as described above does not pertain.

One word of data for any activity not in memory:

0	Flag (=1 - activity is terminating)
1-8	Activity number from .CRSN1
9-17	Demand in 512-word blocks
18-23	Memory allocator urgency
24	Flag (=1 - job is waiting memory)
25	Must be zero
26	Privity indicator. Assume system program if program number is greater than 7, activity number is zero, and privity bit is set
27	Flag (=1 - if new job or new activity) (copy of bit 29, .CRLAL)
28-29	Must be zero
30-35	Program number

Multiple-word entries for any activity in memory where the first word contains:

0	Flag (=1 - activity is terminating)
1-8	GEMORE demand in 512-word blocks
9-17	Number of 512-word blocks allocated
18-23	Number of SSA's
24	Must be zero
25-27	Job status
28-29	Not used
30-35	Program number

The following information is dependent on job status (bits 25-27 of word 1)

Job Status	Information Collected
0	No data follows
1	New memory address
2	Snumb and activity
3	Snumb, activity, new address
4	10 ident words, 2 userid words
5	Ident, userid, new address
6	Ident, userid,snumb, activity
7	Ident, userid, snumb, activity, address

The Memory address word contains the following:

0-17	MBA in 512 word blocks
18-26	LAL in 512 word blocks
27-35	Not used

The Activity word contains the following:

0-8	Not used
9-17	Activity number
18-35	Not used

All multiple word entries contain the following three words:

Current CPU time
Current I/O Time
Memory Use Word

The Memory Use Word contains the following:

0-17	Memory used
18-29	Termination Code
30-35	Not used

At the end of all T10 records the following two words will appear:

0-35	Number of 512-word blocks Available (word 0, .CRPMU table)
0-35	RSCR Time

If a RLSEC request is delayed (e.g. a request to release memory in which TSS is loaded must wait until TSS is swapped), then the number of blocks available may include nonallocatable memory (that portion of the RLSEC beyond the size of TSS). A delayed RLSEC request may be

indicated by consecutive MUM records which show no changes in memory (the MUM writes its record every time that .MP004 is called; in a delayed RLSEC request, .MP004 takes its denial exit without changing the memory state).

5.4.2.2 Trace Type 46. This GCOS system trace is generated every time a job is given a program number and results in a trace type 46 MUM record being generated. The format of the GMC trace type 46 record is shown below.

Word	Bits	Information
1	0-17	Size of record (=3)
	18-26	Not used
	27-35	Octal 46 (trace number)
2	0-29	SNUMB
	30-35	Octal 46
3	0-11	Not used
	12-17	Program number
	18-35	Not used
4	0-35	Time stamp

5.4.3 MSM. The MSM processes GCOS system trace types 7 and 15 by creating its own data collection records to describe the effect of these events. It also processes the specially-generated GMC trace events 73 and 76.

5.4.3.1 Trace Type 7. This GCOS system trace is generated every time a connect is issued and will result in the generation of a GMC trace type 7 record. The format of the GMC trace type 7 record is shown below.

Word	Bits	Information
1	0-17	Size of record (normal = 8, special = 21)
	18-23	Special file code description flags
	18	Permanent (=0), temporary (=1)
	19	Random (=0), sequential (=1)
	20	Not catalogued (=0), catalogued (=1)
	21	Removable (=0), fixed (=1)
	22	Flag (=1 - TSS user file (no file code))
	23	Flag (=1 - SCF File I/O (trace 22 is missing))
	24-26	Processor #
	27-35	Octal 7 (trace number)
2	0-17	I/O's word count
	18-23	Program number
	24-35	File code
3	0-35	System controller time of day

4	0-29	CP time usage
	30-35	IOM command
5	0-5	Not used
	6-35	SNUMB
6	0-5	Device command Special note: A command of octal 72 to a permanent disk pack indicates that a pack exchange is in progress. The .MGPG6 module issues another standby command to the device to which the permanent pack is to be moved. A special device name record should appear either in the current block on tape or at the beginning of the next block to confirm the pack exchange.
	6-17	DCW length
	18-35	File origin block number
7	0-13	File size
	14	Sysout flag
	15	Seek flag
	16-35	Seek address
8	0-5	Device command
	6-11	Device number
	12-17	IOM PUB number
	18-23	I/O Command
	24-26	Not used
	27-29	IOM number
	30-35	Record count
9	0-17	MBA of job issuing connect or zero if nonextended memory
	18-35	I/O queue address in SSA (absolute address if nonextended memory or if value less than 64K; relative address (to MBA) if extended memory and if value greater then 64K)
10	0-17	Activity number
	18	Flag (=1 - I/O status is stopped)
	19-28	Not used
	29-34	I/O status (I/O queue word 0)
	35	Flag (=1 - system job)
11-20		IDENT
21-22		USERID

5.4.3.2 MSM Special Record. During the execution of MSM a special record is written at preselected times during the monitoring session. These records are used to analyze SSA cache core, when configured. The format of this record is shown below. This record is based on data collected during the processing of GMC trace events 73 or 76.

Word	Bits	Information
1	0-17	Size of record (=517)
	18-26	Not used
	27-35	Octal 7 (trace number)
2-516	0-35	a. Number of times each GCOS module 1-515 was in the SSA cache buffer b. Number of times each GCOS module 1-515 was loaded by an I/O because it was not in the SSA cache buffer.
517	0-35	Not used
518	0-35	Flag (=2 - case a. above) (=3 - case b. above)

5.4.3.3 Device Name Record. If either MSM or CM is active, the GMC writes a record which correlates device names to device addresses. The System Configuration Name table is processed sequentially as this record is formatted. Names for all disk devices are reported. In order to detect exchanges of mass storage devices, GMC periodically examines the device name table. If any changes have occurred, then another device name record is written. This record is variable in size, and recognized by the special format of the second word.

Word	Bits	Information
1	0-17	Size of record
	18-26	Not used
	27-35	Octal 7 (trace number)
2	0-35	Octal 535353535353
3-n	0	Flag (=1 - fixed device if mass storage) (set if bits 13 and 14 of the second word of the SCT entry for any mass storage device are both zero; in Shared Mass Storage environment, shared devices must be fixed)
	1-5	IOM number
	6-11	Channel number
	12-17	Device number
	18-35	Device name in BCD

5.4.3.4 FILSYS Catalog Structure Record. During the execution of the Mass Store Monitor, certain MME GEFSYEs GCOS Trace 15 data are collected concerning the catalog file string that is being referenced. The purpose of this data is to try and determine how many connects are being made because of the particular structure of a given catalog or file. This data is also used to provide the catalog file string name associated with the various user file codes that are reported by the Mass Store Monitor. MME GEFSYE traces are only processed if generated by a system program (program number less then 15 or FSTSLV). In addition, only the following GEFSYE's will be

processed: 2, 3, 4, 5, 8, 9, 10, 11, 18, 19, 20, 22, 23, 27, 28, and 29. The format of the GMC record generated is as follows:

Word	Bits	Information
1	0-17	Size of record (variable)
	18-26	Not used
	27-35	Octal 15 (trace number)
2	0-35	-1 if program generating this record is not PALC. Otherwise this word contains a file code in bits 18-35.
3	0-35	-1 if program generating this record is not PALC. Otherwise it contains the SNUMB of the job for which PALC is working.
4	0-17	GEFSYE type
	18-20	Processor #
	21-26	Program #
	27-35	Activity #
5-n	0-35	Catalog file string name - not to exceed 40 words.

5.4.3.5 FMS Cache Record. During the execution of MSM or CM a special record is written at preselected times during the monitoring session. These records are used to analyze FMS catalog cache, when configured. This record is not generated on a WW6.4 system. The format of this GMC record is shown below.

Word	Bits	Information
1	0-17	Size of record (=9)
	18-26	Not used
	27-35	Octal 77 (special flag)
2	0-35	Number of cache hits (word -12 from entry point)
3	0-35	Number of writes (word -11 from entry point)
4	0-35	Number of reads (word-10 from entry point)
5	0-35	Number of reads not in CC (octal 1511 from entry point)
6	0-35	Number of non-320 word reads (octal 1512 from entry point)
7	0-35	Number of skips caused by .SSTAK (octal 1513 from entry point)
8	0-35	Number of cache clears (octal 1514 from entry point)

9	0-35	Number of no hits (octal 1520 from entry point)
10	0-35	Number of hits (octal 1521 from entry point)

5.4.4 CPUM. The CPU Monitor processes the GMC generated event trace type 70.

5.4.4.1 Trace Type 70 - Standard. This GMC record allows six processors to be monitored and allows differentiation between TS1 executive processor time and TS1 subdispatch processor time. If an activity has a program number greater than 14 or FSTSLV, it is considered as a system program if: it is privileged (bit 18 of the .STATE is set) and if it has no J* file for SYSOUT (.SGNPA). This extension of the definition for system programs allows accumulation of processor time used primarily by copies of GEIN. Although DRL TASK jobs have no J* file, they are considered user activities because they are not privileged (the CPU monitor will accumulate processor time associated with termination of DRL TASK jobs as system CPU time since, when terminating, DRL TASK activities are privileged). An activity is recognized as a copy of TSS if bit 13 in its .STAT1 word is set and if its SNUMB is TS2, TS3, or TS4 (TS1 always has program number 5). The check on the .STAT1 word eliminates possible confusion between legitimate copies of TSS and GEIN execution of spawn files or termination of DRL TASK jobs by the same names. If a system program has a SNUMB of $PACT, $MOLT, $POLT, $COLT, $SOLT, or $SLTA its processor time is accumulated, along with that for program number six (test and diagnostics). If a system program described above performs an initialization before it puts its SNUMB into .CRSNB, its processor time may be accumulated in the special category for miscellaneous system programs. The format for this GMC trace type record is shown below.

Word	Bits	Information
1	0-17	Size of record (77 or 83)
	18-26	Not used
	27-35	Trace number (octal 70)
2	0-35	Processor time for system programs not otherwise recognized (e.g. GEIN, DRL TASK termination)
3	0-35	Time for program 1 ($CALC, core allocator)
4	0-35	Time for program 2 ($PALC, peripheral allocator)
5	0-35	Time for program 3 ($SYOT, SYSOUT writer)
6	0-35	Time for program 4 ($RTIN, scheduler)
7	0-35	Time for program 5 (TS1, TS executives #1)

8	0-35	Time for program 6 ($TOLT, T&D executive; also includes time for special T&D SNUMBs)
9-16	0-35	Time for programs 7-14 (decimal) (transaction processor, log-on, FILSYS protection, WIN, DMTEX)
17	0-35	Processor time for GMC
18	0-35	Processor time for user programs
19	0-35	Subdispatch time for program 5 (TS1)
20	0-35	Processor time for TS2 executive
21	0-35	Processor time for TS3 executive
22	0-35	Processor time for TS4 executive
23	0-35	Subdispatch time for TS2
24	0-35	Subdispatch time for TS3
25	0-35	Subdispatch time for TS4
26	0-35	Miscellaneous subdispatch time (expansion capability for TDS, TPE II)
27-51	0-35	Counters for words 2-26
52	0-35	RSCR time
53-58	0-35	Idle time for processors 0-5 (.CRIDT)
59-64	0-35	Overhead time for processors 0-5 (.CROVH)
65	0-35	Number of system jobs in CPU queue
66	0-35	Number of user jobs in CPU queue
67	0-17	Number of system jobs having negative number of nonremote I/O requests (logically impossible condition; number of such I/O requests is .SRQCT, bits 0-17 minus .SREMT, bits 18-35)
	18-35	Number of system jobs having outstanding I/O
68	0-35	Same as word 66, for user jobs
69	0-17	Number of system jobs not in CPU queue and having no I/O requests
	18-35	Number of system jobs in CPU queue with outstanding I/O requests (overlapped CPU and I/O)
70	0-35	Same as word 68, for user jobs
71	0-35	Number of busy processors (does not recognize the interrupt handler)
72	0-35	Counter for determining when to write record
73	0-35	CPU time for special SNUMB 1
74	0-35	CPU time for special SNUMB 2
75	0-35	CPU time for special SNUMB 3
76	0-35	Special SNUMB 1 (BCD)
77	0-35	Special SNUMB 2
78	0-35	Special SNUMB 3

5.4.4.2 Trace Type 70 - Extended. This GMC trace record is identical to the standard type 70 record described in subsection 5.4.4.1 except for six additional words. These words are included only when the special gate loop code is present in the .MFALT module (should always be present in multiprocessor systems; should not be present in a uniprocessor system). This format is shown below. This record is not generated on a WW6.4 system.

Word	Bits	Information
79-84	0-35	Gate loop time for processors 0-5, obtained from .MFALT module (Note: .MFALT deducts gate loop time from processor time charged to jobs and adds it to overhead time reported in .CROVH.)

5.4.5 TM. The Tape Monitor processes three GCOS system traces: 50, 51, and 52 and creates its own data collection records to evaluate the effect of these events.

5.4.5.1 Trace Type 50. This GCOS system trace is generated whenever an activity goes to the core allocator and will result in the generation of a GMC trace type 50 record. The format for this GMC trace type record is shown below.

Word	Bits	Information
1	0-17	Size of record (variable)
	18-26	Not used
	27-35	Octal 50 (trace number)
2	0-29	SNUMB
	30-35	Not used
3	0-35	Time stamp
4	0-11	Activity number
	12-17	Program number
	18-29	Urgency
	30-35	Octal 50
5-N	0-35	Words 1 and 2 of SCT entry for each tape used by this program

5.4.5.2 Special Trace Type 50. The first GMC trace type 50 record is a special trace 50 to indicate the status of all tape drives when the monitor first begins. Its structure is shown below.

Word	Bits	Information
1	0-17	Size of record (variable)
	18-26	Not used
	27-35	Octal 50 (trace number)

2	0-35	Not used
3	0-35	Time stamp
4	0-35	Flag (-2)
5	0-35	SNUMB
6	0-35	Word 0 of SCT table
7	0-35	.CRSN1 for SNUMB
8	0-35	Word 3 of SCT table
9-N	0-35	Repeat of words 5-8 for as many tape drives as are currently configured

5.4.5.3 Trace Type 51. This GCOS system trace is generated every time an activity terminates and will result in the generation of a GMC trace type 51 record. This record structure is identical to the type 50 record structure except for word 4. The format for this word is shown below.

Word	Bits	Information
4	0-11	Abort code
	12-17	Program number
	18-26	Urgency
	27-29	Type of abort
	30-35	Octal 51

5.4.5.4 Trace Type 52. This GCOS system trace is generated every time a program is denied a tape due to unavailability and will result in the generation of a GMC trace type 52 record. The format for this GMC trace type 52 record is shown below.

Word	Bits	Information
1	0-17	Record size (variable)
	18-26	Not used
	27-35	Octal 52 (trace number)
2	0-35	Not used
3	0-35	Time stamp
4	0-35	Flag (-2)
5	0-35	Register A of standard type 52 trace
6	0-35	Register Q of standard type trace
7-N	0-35	Same as special trace 50, words 5-n

5.4.6 CM. The Channel Monitor processes four different GCOS system trace types: 4, 7 and 22. These events cause the generation of the following GMC trace records.

5.4.6.1 Trace Type 4. This GCOS system trace is generated at the termination of an I/O and will cause the generation of a trace type 4 GMC record. The format of the GMC trace type 4 record is shown below.

Word	Bits	Information
1	0-17	Size of record (=3)
	18-26	Not used
	27-35	Octal 4 (Trace number)
2	0-35	Time stamp
3	0-29	A-register of trace
	30-35	IOM number
4	0-17	MBA of job
	18-35	I/O queue address

5.4.6.2 Trace Type 7. This GMC trace record is the same as the MSM trace type 7 record described in subsection 5.4.4.1 and 5.4.4.3. Only one trace type 7 is generated if both the CM and MSM are active.

5.4.6.3 Trace Type 22. This GCOS system trace is generated every time an I/O is requested and will result in the generation of a GMC trace type 22 record. The format of this GMC trace type 22 record is shown below.

Word	Bits	Information
1	0-17	Size of record (=3)
	18	Device busy flag (set if device is busy)
	19	Abort flag (set if bit 5 or bit 6 in .STATE is set)
	20	Swap/move flag (set if bit 7 or bit 8 in .STATE is set)
	21	Flag (=1 - I/O status is stopped)
	22-26	I/O status (bits 31-35 of I/O queue word 0)
	27-35	Octal 22 (trace number)
2	0-35	Time stamp
3	0-35	Device type
	6-11	Device number
	12-17	Channel number
	18-23	Program number
	24-33	Logical primary channel index
	34-35	IOM number
4	0-17	MBA of job
	18-35	I/O queue address

5.4.7 CAM. The Communications Analysis Monitor processes the GMC generated event trace type 14.

5.4.7.1 Trace Type 14. This GMC trace is generated whenever the H6000-355 mailbox in DNWW/MDNET is changed and will result in the

writing of a GMC trace type 14 record. The format for this GMC trace type 14 record is shown below.

Word	Bits	Information
1	0-17	Record size (=variable)
	18-26	Not used
	27-35	Octal 14 (trace number)
2	0-35	Time stamp
3	0-2	355 number
	3-17	Logical line number
	18-35	Terminal ID
4	0-8	Terminal type
	9-17	ICM count
	18-26	OP code
	27-35	Command
5-7	0-23	ICM Data
8	0-23	Not used
	24-35	Data tally
9	0-11	Ignore
	12-17	Status
	18-29	Input data tally
	30-35	Not used
10	0-17	Slave LAL
	18-35	Checksum
11-529	0-35	Communications traffic (only if specific CAM option specified)

5.4.7.2 Special Trace Type 14. This trace record is written during CAM initialization to specify the start time. Its structure is shown below.

Word	Bits	Information
1	0-35	Octal 7000014
2	0-35	Time from MME GETIME
3-8	0-35	Not used

5.4.8 GRTM. The GRTS Monitor processes one GMC trace record, type 62.

5.4.8.1 Trace Type 62. This GMC trace is generated whenever the DATANET-355 GRTS Monitor data record is transmitted to the GMC. The format for this GMC trace type 62 record is shown below.

Word	Bits	Information
1	0-17	Record size (variable)
	18-20	DATANET number
	21-26	Not used
	27-35	Octal 62 (trace number)

Word	Bits	Information
2	0-35	Time stamp - H6000
3	0-17	DAC character count
	18-35	Time stamp - DN-355
4	0-17	010101
	18-35	Buffer denials (cumulative)
5	0-17	010201
	18-35	Buffer availability (current)
6	0-17	010301
	18-35	Number of users (current)
7	0-17	010401
	18-35	Number of transactions sent to host (cumulative)
8	0-17	010501
	18-35	Number of transactions received from host (cumulative)
9	0-17	010601
	18-35	Number of 36-bit words sent to host (cumulative)
10	0-17	010701
	18-35	Number of 36-bit words received from the host (cumulative)
11	0-17	011001
	18-35	Number of host RSVPs received (cumulative)
12	0-17	011101
	18-35	Amount of time in milliseconds spent in idle loop since the last buffer was sent
13	0-17	011201
	18-35	Number of calls to the buffer allocation routine (cumulative)
14	0-17	030105
	18-26	HSLA
	27-35	HSLA subchannel
15	0-17	Number of transmits on S/C (cumulative)
	18-35	Number of receives on S/C (cumulative
16-N		Additional entries depending on the number of subchannels specified on the data card.
N+1		Response Time Buffer. This portion of data is variable depending upon the activity occurring on the DN-355. The various types of data that can be collected in this buffer are illustrated below.

Every line displayed require 18 bits of buffer space.

000010000001000010 Terminal Type / Line ID Time Stamp Direct Access Name (1/2)	Connect-To-Slave Record
000010000010000010 Terminal Type / Line ID Time Stamp	Send Output Record
000010000011000010 Terminal Type / Line ID Time Stamp	Accept Direct Output Record
000010000100000010 Terminal Type / Line ID Time Stamp	Accept Direct Output and Then Input Record
000010000101000010 Terminal Type / Line ID Time Stamp	Accept Direct Input Record
000010000110000010 Terminal Type / Line ID Time Stamp	Input Accepted Record
000010000111000010 Terminal Type / Line ID Time Stamp	Disconnect Record
000010001000000010 Terminal Type / Line ID Time Stamp	Output Received Record
000010001001000010 Terminal Type / Line ID Time Stamp	Output Started Record
000010001010000010 Terminal Type / Line ID Time Stamp	Output Complete Record
000010001011000010 Lost Message Count	Lost Message Record (Always first data in type 2)

The following definitions apply to the above record types.

- Connect-To-Slave A terminal has logged on to an H6000 DAC program.
- Send Output DATANET-355 requesting more output from the H6000.
- Accept Direct Output The H6000 has told the DATANET-355 that it has data to send.
- Accept Direct Output and Then Input The H6000 has told the DATANET-355 that it has data to send and expects input to be returned.
- Accept Direct Input The DATANET-355 asking the H6000 to accept data.
- Input Accepted Input received by the H6000.
- Disconnect A terminal has disconnected from a H6000 DAC program.
- Output Received DATANET-355 has received data from the H6000.
- Output Started DATANET-355 has started to transmit data to a terminal.
- Output Complete DATANET-355 has finished sending data to the terminal.

5.4.9 IDLEM. The Idle Monitor processes a GCOS system trace type 21 by creating its own data collection record to describe the effect of this event.

5.4.9.1 Trace Type 21. The format of the GMC trace type 21 record is shown below. The data in this record is obtained from the occurrence of many different system trace events (see table 5-1).

Word	Bits	Information
1	0-17	Size of record (=3)
	18-20	Processor number
	21-26	Not used
	27-35	Octal 21 (trace number)
2	0-35	Time idle was broken
3	0-35	Time idle started
4	0-35	Not used

5.4.10 TPS. The TPSM processes GCOS system trace types 0, 1, 2, 4, 5, 6, 13, 42, 51, 65 and 74 by creating its own data collection records to describe the effect of these system events.

5.4.10.1 Trace Types 0, 1, 2, 4, 5, 6 and 65. These GCOS system traces are generated during job I/O and execution and result in the generation of a GMC trace type 74 record. The format for this GMC trace type record is shown below.

Word	Bits	Information
1	0-17	Number of words following (record control word)
	18-26	Not used
	27-35	Octal 74 (trace number)
2	0-35	Register A of standard GCOS trace
3	0-35	Register Q of standard GCOS trace
4	0-35	Time Stamp

5.4.10.2 Trace Types 13, 42 and 51. These GCOS system traces are generated for each job start, process, and termination. The TPSM processes these traces for each TPAP and generates the following GMC trace type 74.

Word	Bits	Information
1	0-17	Number of words following (record control word)
	18-26	Not used
	27-35	Octal 74 (trace number)
2	0-35	Register A of standard GCOS trace
3	0-35	TPAP SNUMB
4	0-35	Time Stamp

5.4.10.3 Trace Type 74. This internally generated TPE trace has a variable format depending upon where within TPE the trace was generated.

5.4.11 Special Records. During the execution of the GMC, it sometimes is necessary to generate special records that describe the occurrence of a special event. Following is a description of these special records.

5.4.11.1 Lost Data Record. If the rate of data collection does not allow GMC to dump its internal buffers to tape or if the system develops a tape malfunction, it is possible for GMC to generate a lost data condition. When this condition occurs, a special trace is

generated in the last good record recorded on tape. The next good trace recorded will be found at the beginning of the next physical record.

Word	Bits	Information
1	0-35	000777200100

5.4.11.2 Termination Record. Upon termination, GMC writes out a special termination record. The format is described in subsection 5.6.1.

5.4.11.3 End-of-Reel Flag. When the multireel option is enabled, GMC writes the following special record header at the end of each tape.

Word	Bits	Information
1	0-35	007773400100
2	0-35	Continuation reel number (BCD)

5.4.11.4 MUM Lost Data. If GMC generates a lost data condition while executing the MUM, the MUM generates a special flag in the header. The format of this flag is described below.

Word	Bits	Information
1	0-17	Record size
	18-35	Octal 200110 (lost data flag)

5.4.11.5 Reconfiguraton Record. The format of this record is described in subsection 5.4.1 under the reconfiguration discussion.

5.5 GMF User Input Parameter Options

The user must start here to define his intended use of the GMC so that he can then determine his JCL and system structure.

User control over GMC is total as a complete parameter capability is provided. A sample data parameter card is shown in figure 5-3.

The GMC functional options are:

(1) Capability to turn off any particular monitor or combination of monitors.

(2) Specifying that collection is to halt after filling 1-9 data tapes. The default is to collect an unlimited number of tapes.

CC	
1	
M0 M3	Turn off Monitor 0 and 3
M1	Turn off Monitor 1
M1 M9	Turn off Monitor 1 and collect only a single reel
M1 *12.36,05.00	Turn off Monitor 1, start collecting data at 12.36, and collect for 5 hours
*,03.00	All Monitors are present on the R* file and are active, collection is to start at once and continue for 3 hours
+CK	All Monitors are present on the R* file, and communication traffic is to be monitored for terminal CK
M1 M4 M93	Turn off Monitors 1 and 4, and collect maximum of three reels of data
M*	Suppress abort if GMC cannot move
#VIDEO,HEALS	All Monitors are present on the R* file, and accumulate processor time in the CPU Monitor for these SNUMBS.
M0 M5 M8 ?1	Turn off monitors 0, 5, and 8. Collect only tape connects with the MSM and CM.

Figure 5-3. Data Card Examples

(3) Requesting complete communication data for 1 or 2 terminal IDs.

(4) Suppressing a GMC abort if it cannot move to an acceptable location.

(5) Specifying up to three SNUMBS to be processed by the CPU Monitor.

(6) Requesting that only tape connects or mass storage connects be collected, but not both. The default is to collect both types.

(7) Declaring the start and stop times of monitoring.

(8) Requesting high density tape be collected.

(9) Specifying the monitoring requirements for the GRTM.

5.5.1 On/Off Option. This option allows the user to turn off all monitors not required for his purposes. The GMC default is to have all monitors on. The code format to turn off a given monitor is:

M0 = Memory Utilization
M1 = Mass Store Monitor
M2 = CPU Monitor
M3 = Tape Monitor
M4 = Channel Monitor
M5 = Communications Monitor
M6 = GRTS Monitor
M7 = TPS Monitor
M8 = Idle Monitor
MA-MF = User Developed Monitors

(See Section 13 for a discussion of user developed monitors.)

While it is optional to turn off a monitor, a user must turn off, on the parameter card, any monitor that is not loaded in the compiled R*. Failure to do so will result in an MO-M8 abort. The digit following the M represents the monitor that is not present on the R* file, but yet was not turned off on the parameter card. Details for creation of the R* file are given in subsection 5.6.

5.5.2 Tape Selection Option. This option allows the user to specify the number of data collector tapes to be accumulated in a job run.

M9 = One reel of tape
M91 = One reel of tape
M92 = Two reels of tape
M93(4-9) = Specified number of reels

When this option is used, GMC will terminate with an SF abort.

5.5.3 Terminal Specification Option. This option allows the user to specify the one or two terminal ID's for which it is desired to collect total terminal data. This option may only be selected if the CAM is active and causes all data seen by the H6000 for the selected terminal to be written to the GMC tape.

+ID = Collect data for a single terminal (replace ID with the actual terminal ID)
+ID,ID = Collect data for two terminals

CAUTION: This option can possibly collect passwords and therefore the data tape will be classified to the highest level on the system. Without this option all tapes are unclassified.

5.5.4 Move Option. This option allows the user to suppress an abort if GMC cannot relocate out of the growth range of TSS. See subsection 5.3 for an explanation of the GMC relocation procedure. The proper code for this option is shown below.

M* = suppress abort

5.5.5 CPU SNUMB Option. This option allows the user to specify SNUMBS for the CPU Monitor special option. The CPU Monitor will separately accumulate processor times in its data records for up to three SNUMBS.

#SNUMB1 = Accumulate processor time for a single job (replace SNUMB1 with actual SNUMB of a job)

#SNUMB1,SNUMB2 = Accumulate processor time for two jobs

#SNUMB1,SNUMB2,SNUMB3 = Accumulate processor time for three jobs

5.5.6 Connect Option. This option allows the user to suppress collection of tape connects or mass store connects within the CM or MSM.

?1 = Only tape connects wanted
?2 = Only mass store connects wanted

The default for this option is that all tape and mass storage connects are collected.

5.5.7 Time Option. This option allows the user to specify run time parameters. The time capability is to pre-set a time to begin data collection with a time length to run after collection starts.

*07.00,04.00 = start at 7:00 a.m., run for four hours and stop at 11:00 a.m.
*16.00 = start at 4:00 p.m., no stop specified
*,02.50 = start immediately, stop after 2 1/2 hours

Rules for this option are:

a. The time option must be the last parameter on the data parameter card as the card is read left to right and time is the last entry processed.

b. Asterisk signals GMC to process the time input option.

c. Use four characters for all times in each time entry field. Time is expressed as a 24-hour clock. All zero's must be present on the parameter card.

d. If the time option specifies a start at 0900 for a 4 hour run to 1300, and GMC is not spawned until 1000, the run will still terminate at 1300. In this case, only 3 hours of data will be collected, even though 4 hours of collection was specified.

e. The user can request the following: *22.00, 04.00. This means data collection should begin at 22:00 and continue until 02:00. The GMC will handle the problem of a clock rollover.

f. GMC allocates a tape drive as soon as it initially goes into execution. It keeps this tape drive even when it goes to sleep until told to start up. Therefore, if GMC is spawned at 0700 and told to collect data starting at 1100, the tape drive will be allocated from 0700.

g. If no time option is used, the GMC will start collecting data upon entry into the system and terminate upon a console request or tape limit request. When a time option is used, the GMC will terminate with a TS abort.

5.5.8 Specifying High Density Tape. On tape output, the GMC will write for 1150 records, or to the end of tape mark. If a user desires to alter this procedure so that a high density write (1600 BPI 2100 records) can be performed, the following option should appear on the data card: M;. This option may appear anywhere on the data card, but must preceed the time option request. The user will also need to

modify the $TAPE card in the GMC execution JCL so as to specify 1600 BPI tape collection (see subsection 5.7).

5.5.9 Specifying Monitoring Requirements for the GRTM. In order to collect GRTM data, an M6 must not appear on the first data card. If the M6 is omitted from the first card, then the GRTM is active, in which case additional data cards are required. The additional data cards are free format and indicate the datanets to be monitored, the HSLA subchannels to be monitored, and finally whether response time monitoring is to be performed. By default, only CPU resource monitoring will be conducted. As stated earlier, if the entire monitoring function is to be selected, the GRTS monitor will require approximately 2K of DATANET memory. On the other hand, if only the default option is selected, the monitor will require only 1K of DATANET memory. The required parameter categories are as follows:

Dn = FEP number (n=0 to 7)

HSLAn = High Speed Line Adapter (HSLA) number (n=1 to 3 per FEP)

SCHn = Subchannel numbers associated with each HSLA entry (n=1 to 32)

Rn = Performance response time monitoring on FEP number (n=0 to 7)

Semicolons delimit each of the categories. They also indicate that more GRTS data follows. However, the last data card should not have semicolon at the end. Commas delimit subchannel sets. A "-" specifies a range of values for subchannels.

Example:

```
D1;HSLA1;SCH0-10,14,18-30;HSLA2;SCH3-15,20-30;D0;R0
```

In this example, we will monitor DATANET #1 for CPU resources (by default), for subchannel usage on HSLA 1 subchannels 0-10, 14, 18-30, and HSLA2 subchannels 3-15 and 20-30. No response time monitoring will be performed. For DATANET 0, we will monitor CPU resources (by default), no subchannels will be monitored but response time will be monitored. In order to determine the total memory used by the monitor, the following formula should be used:

```
Memory Used = 1K (default for CPU resource monitoring)
            + 32 words * (number of HSLAs)
            + 8 words * (number of subchannels requested) +
            1K (if response monitoring selected)
```

5.5.10 General Rules of the GMC Data Parameter Card. The following are general rules to be followed in defining the data card:

a. The time option, if selected, must be the last option on the data card.

b. All input elements of the eight options should be separated by a blank character.

5.6 JCL for Creation of an Object File

5.6.1 Introduction to JCL. After the user has completed a study of the options to be specified in the parameter cards described in subsection 5.5 above, the user then must build the JCL that will create the user version of a GMC object file.

The user has optional control over the creation of a GMC object file that will serve his purposes based on functions specified on the parameter cards. This optional structure minimizes the size of the GMC monitor as only necessary code is used and provides, in addition, for easier extension to the capabilities of GMC.

The four functions to be built are initialization, system patch, remove the patch, and primary monitor collection subroutines.

5.6.2 Creation of an Object File. The GMC executive routine has been subdivided into discrete sections of code based on function. In order to generate a usable GMC object file, the individual sections of code must be merged to create a single routine. This procedure has been utilized for two reasons. First, this structure permits the easy addition of new programs, i.e., monitors. Secondly, this structure allows the simple generation of a GMC containing only that code required to capture the necessary data. If a user wants to create a GMC containing only the code necessary for the Memory Utilization Monitor and Mass Store Monitor, he can easily do so. If the user then decides he does not want to run the Mass Store Monitor, he can either recreate a GMC object file or he can turn off the Mass Store Monitor via a data card. Although this procedure sounds complicated, it minimizes the size of the GMC.

When GMF is restored to the user's system, the GMC data collector program is in the form of a catalog structure. This structure is shown in figure 5-2. The GMC catalog structure as it relates to the creation of GMC R* file is shown in figure 5-4. For a description of each file function, refer to table 5-3.

As illustrated in figure 5-1, the GMC consists of an Executive Routine which initializes all the required programs, installs any required system patches, records the system patches, and removes all patches from the system when it is finished. Table 5-3 gives a breakdown of

$:SELECTA:B29IDPXO/GMFCOL/(see below for FILE requirements and options)

REQUIRED	OPTIONAL, WHEN A MONITOR IS USED ALL PROGRAM ELEMENTS OF THE MONITOR MUST BE USED								
GMF.	MUM.	MSM.	CM.	CPU.	TM.	CAM.	GRT.	IDLE	TP
GMF.TOP	MUM.INIT	MSM.INT	CM.INIT	CPU.INIT	TM.INIT	CAM.INIT	GRT.INIT	IDL.INIT	TP.INIT
GMF.MID		MSM.PAT		CPU.PAT		CAM.PAT			
GMF.PATLOOK*1		MSMDOIT		CPUDOIT		CAMDOIT			
GMF.MON		MSM.REMO		CPU.REMO		CAM.REMO			
GMF.BTM	MUM.T10		CM.T04A	CPU.T70	TM.T50	CAM.T14	GRT.T62	IDL.TRCS	TPE200
	MUM.T46		CM.T22A				GRT.COL	IDL.T21	
		CM.T07A*2	CM.T07A						

NOTE-1 GMF.PATLOOK is required only with MSM, CPU and CAM.
NOTE-2 CM.T07A is required with MSM. However, if using both MSM. and CM., then only use only one copy of CM.T07A.

Figure 5-4. GMC JCL Structure

all required GMC files and any optional files. The user selects the programs he wants to monitor in the system, assembles those programs in numerical order, and runs a file-edit job to create a GMC object file. Figure 5-5 is an example of a GMC containing the Memory Utilization, Idle, and CPU Monitors. Figure 5-6 is an example of a GMC containing the Mass Store Monitor, Channel Monitor, and Idle Monitor. A $ GMAP card is required before the SELECTA for /GMF.TOP, and before every SELECTA after /GMF.BTM. Under normal operating conditions, the FILEDIT activity will contain multiple "Inconsistent Deck Name" error messages, which can be ignored. If a user should improperly create an R* file by omitting a required file, the GMC execution will abort with an S1-S9 abort, or an SA, SC, or SD abort, depending upon which routine is missing. The user should refer to table 5-2 for an explanation of these aborts.

The GMF is designed to be run on a HIS 6000 computer system, running with WWMCCS GCOS release 6.4 or 7.2. These releases are equivalent to the HIS commercial 2H or 4JS1 GCOS releases.

When GMF is used on WWMCCS release 7.2, or commercial release 4JS1-4JS3, the user must insure that the value for variable "SYS64" is set to 0. This variable is defined in an "EQU" statement located in the following files: B29IDPXO/GMFCOL/GMF/GMF.TOP, B29IDPXO/GMFCOL/CM/CM.T07A, B29IDPXO/GMFCOL/CPU/CPU.T70 and B29IDPXO/GMFCOL/MUM/MUM.T10. See subsection 2.6.2 for a discussion of other GMC modifications that are required under different GCOS software releases.

Having created a GMF object file, no other system modifications are required unless the GRT Monitor or the TPS Monitor is desired. Both of these monitors require system modifications to be made prior to their use. The system modifications required by the GRTS Monitor are described in subsection 5.2.7 of this chapter. The system modifications required by the TPS Monitor are described in subsection 5.2.9 of this chapter.

5.7 JCL for Executing the GMC

The JCL needed to execute the GMC is shown in figure 5-7. The size to be placed on the $ LIMITS card depends on the number of monitors present in the R* file. The size should range from 15K to 24K, depending on the number of monitors. The load map produced on the compilation listing from the General Loader will specify the actual memory size required to load GMC. In figure 5-7, parameter card following $ DATA I* demonstrates a turn-off for the MUM, CPUM, TM, GRTM, IDLE, TPSM monitors, and a collection of an unlimited number of tapes. If the GRTS monitor is active, it may dynamically grow GMC during its initialization procedure. Because of this feature, the GRTS monitor requires a $ LIMITS card with a large SYSOUT request to force the system to obtain an extra 1K memory. Figure 5-8 shows the

```
$       FILEDIT SOURCE,OBJECT, INITIALIZE
$       PRMFL   R*,W,S,B29IDPXO/GMFCOL/GMF.OBJ
$       FILE    K*,NULL
$       DATA    *C,CCPY
$       LOWLOAD
$       OPTION  ERCNT/500/
$       GMAP    NDECK
$       SELECTA B29DIPXO/GMFCOL/GMF/GMF.TOP
$       SELECTA B29IDPXO/GMFCOL/MUM/MUM.INIT
$       SELECTA B29IDPXO/GMFCOL/CPU/CPU.INIT
$       SELECTA B29IDPXO/GMFCOL/IDLE/IDL.INIT
$       SELECTA B29IDPXO/GMFCOL/GMF/GMF.MID
$       SELECTA B29IDPXO/GMFCOL/CPU/CPU.PAT
$       SELECTA B29IDPXO/GMFCOL/PATLOOK
$       SELECTA B29IDPXO/GMFCOL/CPU/CPUDOIT
$       SELECTA B29IDPXO/GMFCOL/GMF/GMF.MON
$       SELECTA B29IDPXO/GMFCOL/CPU/CPU.REMO
$       SELECTA B29IDPXO/GMFCOL/GMF/GMF.BTM
$       GMAP    NDECK
$       SELECTA B29IDPXO/GMFCOL/IDLE/IDL.TRCS
$       GMAP    NDECK
$       SELECTA B29IDPXO//GMFCOL/IDLE/IDL.T21
$       GMAP    NDECK
$       SELECTA B29IDPXO/GMFCOL/MUM/MUM.T10
$       GMAP    NDECK
$       SELECTA B29IDPXO/GMFCOL/MUM/MUM.T46
$       GMAP    NDECK
$       SELECTA B29IDPXO/GMFCOL/CPU/CPU.T70
$       EXECUTE
$       ENDEDIT
$       ENDCOPY
```

Figure 5-5. Creation of R* File for Memory, Idle, and CPU Monitor

```
$      FILEDIT     SOURCE,OBJECT,INITIALIZE
$      PRMFL       R*,W,S,B29IDPXO/GMFCOL/GMF.OBJ
$      FILE        K*,NULL
$      DATA        *C,COPY
$      LOWLOAD
$      OPTION      ERCNT/500/
$      GMAP        NDECK
$      SELECTA     B29IDPXO/GMFCOL/GMF/GMF.TOP
$      SELECTA     B29IDPXO/GMFCOL/MSM/MSM.INIT
$      SELECTA     B29IDPXO/GMFCOL/CM/CM.INIT
$      SELECTA     B29IDPXO/GMFCOL/IDLE/IDL.INIT
$      SELECTA     B29IDPXO/GMFCOL/GMF/GMF.MID
$      SELECTA     B29IDPXO/GMFCOL/MSM/MSM.PAT
$      SELECTA     B29IDPXO/GMFCOL/PATLOOK
$      SELECTA     B29IDPXO/GMFCOL/MSM/MSMDOIT
$      SELECTA     B29IDPXO/GMFCOL/GMF/GMF.MON
$      SELECTA     B29IDPXO/GMFCOL/MSM/MSM.REMO
$      SELECTA     B29IDPXO/GMFCOL/GMF/GMF.BTM
$      GMAP        NDECK
$      SELECTA     B29IDPXO/GMFCOL/CM/CM.T04A
$      GMAP        NDECK
$      SELECTA     B29IDPXO/GMFCOL/CM/CM.T22A
$      GMAP        NDECK
$      SELECTA     B29IDPXO/GMFCOL/CM/CM.T07A
$      GMAP        NDECK
$      SELECTA     B29IDPXO/GMFCOL/IDLE/IDL.TRCS
$      GMAP        NDECK
$      SELECTA     B29IDPXO/GMFCOL/IDLE/IDL.T21
$      EXECUTE
$      ENDEDIT
$      ENDCOPY
```

Figure 5-6. Creation of R* File for Mass Store Monitor, Idle and Channel Monitor

```
$       OPTION  ERCNT/999/
$       LOWLOAD
$       EXECUTE DUMP
$       PRMFL   R*,R,S,B29IDPXO/GMFCOL/GMF.OBJ
$       LIMITS  99,16K
$       PRIVITY
$       TAPE    OT,X2D,,99999
$       FILE    DK,X1R,300R
$       DATA    I*
M0 M2 M3 M6 M7 M8 (optional)
$       ENDJOB
```

*NOTE - The execution report from GMC will contain multiple "nonfatal error" messages which can be ignored.

**NOTE - If high density tape collection is desired, the tape card should be modified with the addition of four commas after the tape number followed by the words DEN16:

```
$     TAPE     OT,X2D,,12345,,,,DEN16
```

and also the option M; should be on the data card.

Figure 5-7. JCL for Executing the GMC

```
$       LOWLOAD
$       OPTION       ERCNT/500/
$       EXECUTE      DUMP
$       PRMFL        R*,R,S,B29IDPXO/GMFCOL/GMF.CBJ
$       LIMITS       99,15K,,99999
$       PRIVITY
$       TAPE         OT,X2D,,,,GRTSII-DATA
$       FILE         DK,X1D,300R
$       DATA         I*
M0 M1 M2 M3 M4 M5 M7 M8 M9 MA
 DO;HSLA1;SCH0-8,14,18,21-23;D1;R0
$       ENDJOB
```

Figure 5-8. GRTM JCL

JCL needed to execute a GMC session which includes the GRTM. Since the GMC runs in master mode, it requires a PRIVITY card, and the operator must grant it permission to run. The DK file is optional but must be present if more than one reel will be collected. The size of the DK file is approximately 300 links but may require more than 300 links on a very busy system. This file is used to collect data during rewind of a completed data tape. When GMF loads, many load error messages will be produced. These error messages may all be ignored.

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 6. MEMORY UTILIZATION MONITOR DATA REDUCTION PROGRAM

The Memory Utilization Data Reduction Program (MUDRP) is a FORTRAN program which uses the GMC output tape to produce a series of reports presenting various aspects of memory utilization. Data collected by the Idle Monitor will also be processed by MUDRP and reported as part of the MUM reports.

6.1 Inputs

The Memory Utilization Data Reduction Program has two inputs. The first is the data collection tape produced by the General Monitor Collector (see section 5). The second input is a set of control cards specifying the output report options.

6.1.1 Report Options. The MUDRP reports consist of histograms, serial plots, and general report outputs. These reports have a number of parameter selections which can be modified by card input at run time. Any report may be turned on or off, and a set of time spans may be specified for measurement.

6.1.2 Default Options. Table 6-1 lists all reports produced by default. All reports except the Memory Map and Out of Core Report are produced unless specifically turned off, by user request.

6.1.3 Histogram Options. There are five characteristics for each histogram directly available to the user. These include the ranges and resolution of display as well as the descriptive titles. The format of a histogram report is completely described later in this chapter (section 6.3.2).

The first of these characteristics is the lowest value, LOWVAL. Any input received by the histogram that is less than this value will be entered into the first histogram bucket, along with all entries that are less than the starting value of the next bucket.

The next entry range, the interval size of each histogram entry, is determined by the INTVSZ parameter. It specifies the size of each entry range or "bucket."

The size of the histogram is determined from the parameter TABSIZ which specifies how many "buckets" or entry ranges are contained in this histogram. TABSIZ also specifies the upper value which could fall within the display range of the histogram. If an entry is made above this range, it is placed in an out-of-range "bucket" of the histogram. The number of the out-of-range occurrences are output with the histogram, along with their average value, so that the histogram can be altered to handle the variability of the range better. The user should note that a compile time parameter of MXTBSZ determines how large any one histogram can become. If an increase beyond this is desired, MXTBSZ is increased along with the memory size of the data reduction program. There are two ways to modify the histograms so as to include the out-of-range values. The first method would involve increasing the internal size of a histogram bucket by altering the value of INTVSZ. In this way, the histogram would

Table 6-1. Default Reports (Part 1 of 3)

ID Number	Histogram Title
1	Memory Demand Size of New User Activities in 1K Word Blocks
2	The Original Allocation Time for User Memory in 1/10 Second
3	The Total Elapsed Time a User Activity was Swapped
4	The Number of Times a User Activity was Swapped
5	The Request Size of GEMORES
6	The Percent of Size-Time Product Used by a User Activity
7	The GEMORE Service or Denial Time - 1/10 Second
8	The Elapsed Time a User Activity Was in Memory
9	The Elapsed Duration of a User Activity in Tenths of a Second
10	The Ratio of User Activity Duration Versus Memory Use Time
11	The Memory Demand Size of All Demand Types
12	Elapsed Time Between Allocator Calls in 1/100 of a Second
13	Number of Extra Activities That Could Fit in Memory With Compaction
14	Number of Activities Waiting for Memory in the Allocator Queue
15	Number of Activities Residing in Memory
16	Elapsed Time of a Busy State (All Processors)
17	The Total Amount of Available Memory
18	The Total Memory Demand Outstanding
19	Demand Outstanding When a Processor Went Idle
20	Number of Activities in Memory When a Processor Went Idle

Table 6-1. (Part 2 of 3)

ID Number	Histogram Title
21	Number of Activities Waiting Memory When a Processor Went Idle
22	Memory Available When a Processor Went Idle
23	Memory Demand Size Versus Memory Wait Time
24	Used in Conjunction with ID 23
25	Percent of Assigned Memory Used (Time-Corrected)
29	Number of User Activities Waiting Memory in the Allocator Queue
30	Number of User Activities in Memory
31	Elapsed Time of a Busy State Processor 0
32	Elapsed Time of a Busy State Processor 1
33	Elapsed Time of a Busy State Processor 2
34	Elapsed Time of a Busy State Processor 3
35	CP Time per User Activity
36	I/O Time per User Activity
40	Number of Activities Waiting Memory (Time-Corrected)
41	Number of Activities in Memory (Time-Corrected)
42	Memory Available (Time-Corrected)
43	Number of User Activities Waiting Memory (Time-Corrected)
44	Number of User Activities in Memory (Time-Corrected)
45	Total Demand Outstanding (Time-Corrected)
46	Number of Extra Activities That Could Fit in Memory Without Compaction
48	Length of an Idle State (All Processors)
49	Length of an Idle State Processor 0

Table 6-1. (Part 3 of 3)

ID Number	Histogram Title
50	Length of an Idle State Processor 1
51	Length of an Idle State Processor 2
52	Length of an Idle State Processor 3
53	Number of Times System Activity Swapped
54	Elapsed Time a System Activity was Swapped
55	Elapsed Time of a Busy State Processor 4
56	Elapsed Time of a Busy State Processor 5
57	Length of an Idle State Processor 4
58	Length of an Idle State Processor 5

ID Number/Name	Plot Title
26/PLOT1	Availability of Memory vs. Outstanding Demand In Core Allocator Queue vs. Outstanding Demand in Peripheral Allocator Queue Plus Outstanding Demand In Core Allocator Queue
27/PLOT2	Memory Shortfall in Core Allocator Queue vs. Memory Shortfall in Core Allocator Queue Plus Memory Shortfall in Peripheral Allocator Queue
28/PLOT3	Number of Activities in Core Allocator Queue vs. Number of Activities in Peripheral Allocator Queue
59/PLOT4	Average size of TSS, FTS and NCP

ID Number/Name	Other Reports
37/PALC	Peripheral Allocator Report
38/ACTIVE	Activity Report/Excessive Resource Report/Abort Report/IDENT Report
39/MAP	Memory Map
47/OUT	Out of Core Report
---	Special Job Memory Reports

cover a larger range of values. This change could be made via data cards and would not increase the size of the program.

The second method would involve increasing the size of the histogram by altering the value of TABSIZ. As long as the size requested does not exceed 50, this change can also be done via a data card. However, if an individual histogram needs to be larger than 50 buckets, the user will need to change the value of MXTBSZ. This change will require a change to source code, a recompile, and probably, an increase in program size. All references to MXTBSZ must be altered. This would need to be done in the EDIT subsystem of Time-Sharing.

The remaining items that can be modified are the title and the vertical axis headers. Table 6-2 shows the default values for all histograms.

6.1.4 Plot Options. There are three characteristics directly available to the user for each individual plot axis used.

The first characteristic, MAXNUM, is the maximum number of entries to be plotted on each vertical plot axis.

The second characteristic, YMAX, defines the upper limit of the horizontal display axis.

The third characteristic, YMIN, defines the lower limit of the horizontal display axis. Table 6-3 shows the default values for all plots.

6.1.5 Default Option Alteration. The general format for an option request is as follows: The first card contains an action code describing the action to be taken. Subsequent cards modify report parameters for some of the action codes. All input cards are free format with the only requirement being that at least one blank space separates multiple input parameters. The very last input card must have the word "END" typed on it. This card must be present whether or not any other input options are selected. Available actions with their (default) implications are shown in table 6-4. There is no order required for the options. In reading the following sections it should be remembered that the first card for any input option must be the action code specification with no other data present on the card.

The user should take special note that if this software is executed under a WW6.4/2H GCOS release, an additional data card is required. This data card is not described elsewhere in this chapter. The data card should contain the letters RN.

Table 6-2. Default Values for Histograms

ID #	Low Value	Interval Size	Number of Buckets
1	4	4	40
2	0	50	40
3	0	250	40
4	0	1	40
5	4	4	40
6	0	1	45
7	0	5	40
8	0	200	40
9	0	200	40
10	.95	.1	40
11	4	4	40
12	0	10	40
13	0	1	40
14	0	1	40
15	0	1	40
16	0.0	5.0	45
17	0	10	40
18	4	10	40
19	4	20	40
20	0	1	40
21	0	1	40
22	4	8	40
23	4	4	40
25	50	2	40
29	0	1	40
30	0	1	40
31	0.0	5.0	40
32	0.0	5.0	40
33	0.0	5.0	40
34	0.0	5.0	40
35	5	5	45
36	5	5	45
40	0	1	40
41	0	1	40
42	0	10	40
43	0	1	40
44	0	1	40
45	0	10	40
46	0	1	40
48	0.0	5.0	40
49	0.0	5.0	40
50	0.0	5.0	40
51	0.0	5.0	40
52	0.0	5.0	40
53	0	1	45
54	0	250	40
55	0.0	5.0	40
56	0.0	5.0	40
57	0.0	5.0	40
58	0.0	5.0	40

Table 6-3. Default Values for Plots

ID #	Max Size of Plot	Lower Plot Limit	Upper Plot Limit
26	Unlimited	0.	378.
27	Unlimited	0.	378.
28	Unlimited	0.	63.
59	Unlimited	0.	252.

Table 6-4. Available Report Actions and Their (Default) Values

HISTG - Modify a histogram (see table 6-2)

PLOT - Modify a Plot (see table 6-3)

ON - Turn a specific report on - (all reports on except Memory Map and Out of Core Report)

OFF - Turn a specific report off - (all reports on except Memory Map and Out of Core Report)

TIME - Set a time span (s) for reporting - (Total time reported)

ALLOFF - Turn all reports off except those specified - (all reports on except Memory Map and Out of Core Report)

ALLON - Turn all reports on except those specified - (all reports on except Memory Map and Out of Core Report)

ERROR - Do not stop on an option request error - (stop on an input error)

DEBUG - Program debug requested - (no debug)

ALLOC - Stop program after a specified number of memory allocations have been requested - (entire tape processed)

NREC - Stop program after a specified number of tape records have been processed - (entire tape processed)

NOUSER - Do not print USERID on any report - (USERID printed on certain reports)

IDLE - Turn off all Idle Monitor reports - (all IDLE reports on)

WASTED,CORE,IO,CPU,RATIO- Changes parameters used in the Excessive Resource Usage Report - (20K,50K,30MIN,30MIN,5)

ABORT - SNUMBS not to report in the ABORT Report - (all SNUMBS that abort are reported)

PLTINT - Change Interval at which plots are printed - (10 MIN)

FSTSLV - Change the lowest allowable user program number - (15 decimal)

MASTER - Define SNUMBS that are considered to be SYSTEM jobs - (all programs with a program number less then FSTSLV)

PALC - Change the print control for the PALC report (600 secs)

END - Required as last card of input. It must be present.

SPECL - Produce the Special Job Memory Reports

6.1.6. Histogram Alterations (Action Code HISTG). A complete description of histogram default values and their meanings is provided in section 6.1.3. In order to change any histogram parameter the user is required to supply two data cards. The first data card describes the parameter to be changed and the second card provides the new value for the parameter. The following options are available:

Card #1	Card #2
LOWVAL	A new low value
SIZE	A new maximum histogram size
BUCKET	A new bucket size
HEADER	A 2-word header separated by at least one blank. Each header word must not exceed six characters in length. If one of the headers is to be blank, the word BLANK must be typed on the data card.

Two additional points must be stressed.

- The set of parameter cards just described must be preceeded by two data cards. The first data card contains the word HISTG and second data card contains the ID number of the histogram to be modified (see table 6-1).

- When inputting the new parameter values the user must consult table 6-2 in order to determine whether the parameters must be inputted as integer (no decimal point), or as real numbers (decimal point must appear on data card).

Figure 6-1 shows a standard histogram format. Column five of this histogram has the words "NUMBER" and "WAIT". These are called the header labels and are used to describe the function being reported by this histogram. It is these two words that the user may modify with the HEADER parameter card. Figure 6-2 shows the input option formats for this action code.

6.1.7 Plot Alterations (Action Code PLOT). Modifications to a plot allow the user to specify a new plot size, a new maximum horizontal axis limit and a new minimum horizontal axis limit. The default values for the existing plots are described in section 6.1.4. As with the histogram option the user is required to supply two data cards for each parameter change desired. The first data card describes the parameter to be changed and the second data card provides the new value for the parameter. The following options are available:

Card #1	Card #2
SIZE	A new maximum plot size
LOWVAL	A new low value
HIVAL	A new high value

```
                    DISTRIBUTION COLLECTED ON SYSTEM NMCC2  AT 12:39:46 ON 80-12-15

                    THE # OF USER ACTIVITIES WAITING MEMORY IN ALLOCATORS QUEUE

INDIV.   CUMUL.   CUMUL.   INDIV.   NUMBER              PERCENT OF OCCURRENCE                  REPORT
NUMBER   NUMBER    PRC      PRC      WAIT    00   05   10   15   20   25   30   35   40   45   50    10
                                              I....I....I....I....I....I....I....I....I....I....I
  1456     1456    6.220    6.220    0-   0  IXXXXXX
  2257     3713   15.861    9.641    1-   1  IXXXXXXXXXX
  3949     7662   32.730   16.869    2-   2  IXXXXXXXXXXXXXXXXX
  5456    13118   56.036   23.306    3-   3  IXXXXXXXXXXXXXXXXXXXXXXX
  4053    17171   73.349   17.313    4-   4  IXXXXXXXXXXXXXXXXX
  2924    20095   85.839   12.490    5-   5  IXXXXXXXXXXXX
  1836    21931   93.682    7.843    6-   6  IXXXXXXXX
   878    22809   97.433    3.751    7-   7  IXXXX
   317    23126   98.787    1.354    8-   8  IX
   114    23240   99.274    0.487    9-   9  I
   133    23373   99.842    0.568   10-  10  IX
    34    23407   99.987    0.145   11-  11  I
     3    23410  100.000    0.013   12-  12  I

 23410 ENTRIES TOTAL   AVERAGE =   3.40961    VARIANCE =   3.821    STANDARD DEVIATION =   1.955
```

Figure 6-1. Standard Histogram

```
Card   1     A
       2     B
       3     C     repeat this set for each
       4     D     parameter to be changed
     2+N     E
```

where

A = the word HISTG
B = histogram ID number (Table 6-1)
C = parameter control word
D = new parameter value. If parameter control word was HEADER then this card must contain two words separated by at least one blank. Each word cannot exceed six characters in length. If the user desires one of the words to contain blanks he must type the word BLANK on the card.
E = new action command (table 6-4)

Figure 6.2. HISTG Action Code Format

Several points must be stressed.

- o The set of parameter cards just described must be preceded by two data cards. The first data card contains the word PLOT and the second data card contains the ID number of the plot to be modified (see table 6-1).

- o When inputting parameter values for LOWVAL and HIVAL these values must be inputted as real numbers (decimal point must appear on data card).

- o When inputting parameter values for SIZE the value must be inputted as an integer. If the size is to be unlimited then a -1 must be inputted.

  Figure 6-3 shows a standard plot format. The maximum and minimum values of the plot are used to determine the value of each dash across the horizontal axis. In this figure each dash has a delta value of 5.00 E-01. Figure 6-4 shows the format for this input option.

6.1.8 Turn a Report On (Action Code ON). This card allows a user to turn on a single report that is off by default. Card 1 contains the word ON and card 2 contains the ID name of the report to be turned on (Table 6-1). No change to the default parameter, of the report, will be made. This option may be used only for Plots and Other Reports and cannot be used to control individual histograms.

6.1.9 Turn a Report Off (Action Code OFF). This card allows a user to turn off a single report that is on by default. Card 1 contains the word OFF and card 2 contains the ID name of the report to be turned off (table 6-1). No change to the default parameters, of the report, will be made. This option may be used only for Plots and Other Reports and cannot be used to control individual histograms.

6.1.10 Set a Timespan of Measurement (Action Code TIME). The timespan of data collection can cover many hours of which only a few may be of interest. This option allows a user to specify the timespan (or spans) to be displayed in all reports. For example, the user may specify that he wants to collect data from 0500 to 2200 and wants to display data only from 0900 to 1700 in all reports. As another option the user may request to see the memory map from 0900 to 1000, plot #1 from 1200 to 1500 and all other reports from 0800 to 1700.

The user must specify the report ID name to be affected by the time request (table 6-1). If the entire reduction (all reports) are to be time controlled, a report ID name of "TOTAL" must be used. Histogram reports cannot be individually time spanned. All time spans of plots or other reports will be bound by the total report timespan, if one is to be used. Up to five timespans for each report or plot may be specified, and they must be serially ordered. All times are expressed as SIMI where SI is the hour and MI is the minute. All time must be expressed as four character fields with no intervening blanks. Time is based on a 24-hour

```
                         DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 12:39:46 ON 80-12-15

                               # OF ACTIVITIES IN CALC QUEUE VS # IN PALC QUEUE


 DELTA =   5.0000E-01     A=NCALC     B=NPALC

TIME OF DAY                                                NUMBER WAITING
     0.                            1.5750E 01                   3.1500E 01

Y---------Y---------Y---------Y---------Y---------Y---------Y---------Y---------Y-

I 12:49:21:80
2
2
2
2
2
2
2
2 A
I 14:21:23:10
B   A
B     A
B       A
B                 A
B         A
B         A
B     B       A
I       B  A
I     B     A
I 16:01:34:50
I         B A
I     B   A
```

Figure 6.3. Standard Plot

Card	1	A	
	2	B	
	3	C	repeat this set for each
	4	D	parameter to be changed
	2+N	E	

A = the word PLOT
B = plot ID number (Table 6-1)
C = parameter control word
D = new parameter value
E = new action command (table 6-4)

Figure 6-4. PLOT Action Code Format

clock. If a user wants to request the time 4:07 he must input 0407. All times must include four characters.

If a start time but no stop time is desired, no characters should be entered after the minutes of the start time. If a stop time is requested there must be a start time corresponding to it. If the user wants to start at the beginning of data collection and stop at some specified time, but is not sure of the start time, a start time of 0001 should be used. Figure 6-5 shows the format for this option.

6.1.11 Turn All Reports Off Except Those Specified (Action Code ALLOFF). All reports except those explicitly identified here are to be turned off. The inputs consist of

A B C . . . Y (max of 25)

where A through Y are the report ID numbers (table 6-1) to be turned on. The format is shown in figure 6-6. This option will control the printing of all reports, including histograms.

6.1.12 Turn All Reports On Except Those Specified (Action Code ALLON). All reports except those explicitly identified here are to be turned on. The input consists of

A B C . . . Y (max of 25)

A through Y are the report ID numbers (table 6-1) to be turned off. The format is the same as action code ALLOFF (see figure 6-6). This option will control the printing of all reports, including histograms.

6.1.13 Continue Data Reduction After an Input Option Error (Action Code ERROR). This code allows data reduction to continue when an error has been detected and reported in an input option request. The default value will abort data reduction and report the error. Only the Action Code card is required.

6.1.14 Debug For a Given Program Number (Action Code DEBUG). This is a debug option which supplies large amounts of output for a given program number. It should be used only in cases of data reduction problems. Card 1 contains the word DEBUG and card 2 contains a program number.

6.1.15 Stop After a Specified Number of Tape Records Processed (Action Code NREC). This option is useful when a tape problem occurs and the entire tape cannot be processed. When this occurs, the program will usually abort with an I/O error and some reports might be lost. If a tape error does occur during data reduction, the operator should type a "U" in response to the operator action request made by GCOS in processing tape errors. If the operator performs this action the data reduction program will abort gracefully.

Unfortunately, there are times when a tape error will cause a program abort without giving the operator a chance to respond with a "U". In these cases reports will be lost and this option will need to be used

```
Card  1   A
      2   N M
      3   B C D E ...
```

where
A = The word TIME
N = Report ID name to be time spanned (table 6-1)
M = Number of different times appearing on Card 3
B,C,D,E = Start and stop times used to define the time spans. Times must be separated by one or more blanks.

Figure 6-5. TIME Action Code Format

```
Card  1 = A
      2 = N
      3 = B C D E ...

 where
A = The word ALLOFF or ALLON
N = The number of report ID's appearing on card 3    cannot exceed 25
B,C,D,E = ID numbers of those reports not to be turned OFF/ON
```

Figure 6-6. ALLOFF/ALLON Action Code Format

in order to stop data reduction processing prior to the tape error. The first card contains the word NREC and the second card contains the number of tape records to be processed.

6.1.16 Suppress USERID (Action Code NOUSER). This action code is used to suppress the printing of USERIDs on those reports where the USERID normally appears. Only the Action Card is required.

6.1.17. Turn Idle Reports Off (Action Code IDLE). This option will turn off a histograms dealing with idle CPU information (i.e., report IDs 16, 19, 20, 21, 22, 31-34, 43-54, 55-58). The user should realize that these reports are useful in determining the I/O boundness of the system. However, on most systems, the idle trace is 70 percent of the entire tape, so that, by turning off this processing, processing time can be reduced by over 50 percent. Only the action card is required for this option.

6.1.18 Change Excessive Resource Limits Used in Excessive Resource Report (Action Codes WASTED, CORE, IO, CPU, and RATIO). This report lists all jobs which are above a preset threshold for any of the following resources:

Wasted Memory
Excessive Memory
Excessive CPU time
Excessive I/O time
Excessive Ratio

These limits are currently set to the values specified in table 6-4 and may be changed by using this option. The format for this option consists of Card 1 specifying the action code and Card 2 specifying the new threshold limit. This report is explained later in this chapter.

6.1.19 Eliminate SNUMBs From Abort Report (Action Code ABORT). This report lists all activities that fail to go to EOJ (i.e. Abort). The details of the report are given in section 6.3 of this chapter. At times, jobs are designed in such a way that they can be terminated only via a MME GEBORT or operator command. While these jobs do not go to EOJ, they have processed correctly and have not resulted in wasted computer resources. This option allows the user to request that these jobs not be included in the Abort Report. The first card contains the action code ABORT. The second card contains the number of jobs that will be deleted from the Abort Report. This number may not exceed 10. If more then 10 jobs are listed only the first 10 will be deleted. The third card contains the SNUMB of each job to be deleted. Each SNUMB must be followed by at least one blank column.

6.1.20 Change the Plot Interval (Action Code PLTINT). Currently, all plots are outputted at ten minute intervals. The plot interval controls the output of all plots; i.e., one plot cannot have a different time interval then another plot. The first card of this option contains the action code PLTINT. The second card contains the new plot interval inputted in minutes.

6.1.21 Change the Program Number for the First Slave Job (Action Code FSTSLV). In the GCOS system certain program numbers are assigned to system jobs. For example $CALC is program number 1, $PALC is program number 2, $SYOT is program number 3, etc. In the WWMCCS system all programs with a program number less than 15 (decimal) are considered system programs. This option allows the user to alter this program number from its default value of 15. The first card contains the word FSTSLV and the second card contains the new program number. For non-WWMCCS systems, FSTSLV should normally be set to 10.

6.1.22 Request that Certain Jobs be Considered System Jobs (Action Code MASTER). There are certain jobs executed during the course of a day, which have program numbers that would designate these jobs as user jobs. However, in actuality they are system jobs and should be considered as system overhead. Examples of such jobs are VIDEO, HEALS, the GMF MONITOR, etc. This option allows the user to define up to ten jobs that should be considered as system jobs. The first card contains the Action Code MASTER. The second card contains the number of jobs to be defined as system jobs. The third card contains the SNUMB of each job to be considered as a system program. Each SNUMB must be followed by at least one blank column.

6.1.23 PALC Report Print Control (Action Code PALC). Due to the excessive amount of output possible from the PALC report, a time control can be set to print only those activities that are in any PALC state greater than the time limit. This time limit defaults to 600 seconds (10 minutes). The first card contains the word PALC and the second card contains the new time limit, in seconds.

6.1.24 Request the Special Job Memory Reports (Action Code SPECL). If the analyst desires to track the memory demands for a specified number of jobs (not to exceed 10), this input option should be invoked. This option will cause two reports to be produced. One report will indicate every time the requested job(s) was swapped or issued a MME GEMORE for memory, how long it was swapped, or how long the GEMORE was outstanding, and how much memory the job(s) required. A second report will also be produced which indicates the average memory size of the job(s) during the course of its execution. This average is taken over increments of time where the time increment used, is the same increment that is used to produce the series of plots. The option consists of three cards where the first card contains the word SPECL, the second contains the number of jobs to be analyzed, and the third card contains the list of SNUMBs separated by at least one blank column.

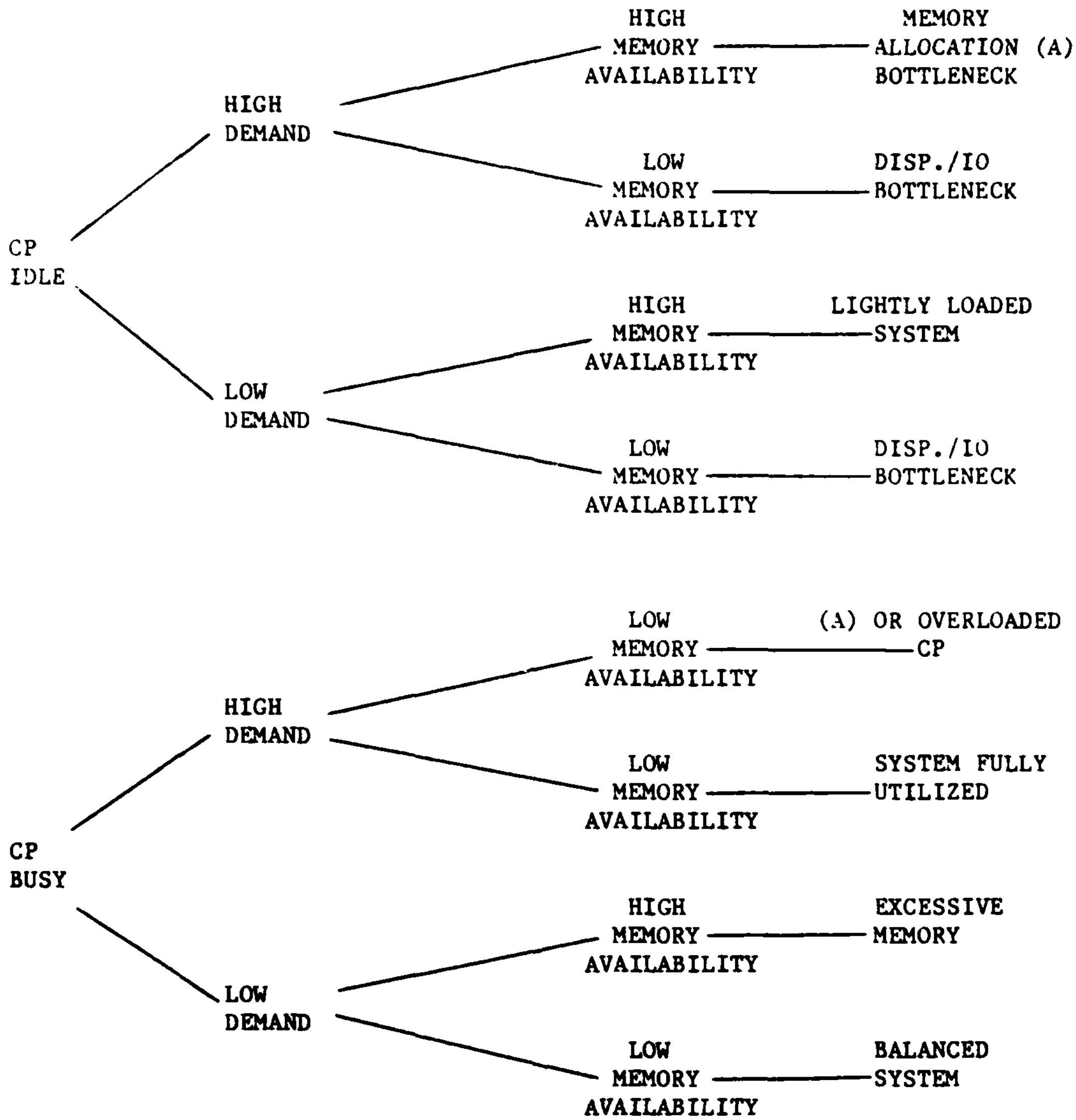


Figure 6-7. System Bottleneck Chart

6.2 Processing

6.2.1 General. The reports of the MUDRP are intended to aid in the following:

- System sizing - both memory sizing and processor utilization.
- Job flow analysis - determining if and where a bottleneck exists and the user memory loading and the daily load distributions.
- System perturbation measures - allows the user to evaluate how a new procedure or new load may alter the utilization of the system as well as determine the total utilization/capacity of the system.
- Large user jobs - aid in identifying specific jobs which are misusing or "hogging" system resources.

Figure 6-7 illustrates how the monitor will pinpoint these various areas. For example, if the monitor indicates a large percentage of processor idleness with high memory demand and low memory availability, a dispatching or I/O bottleneck would be indicated. This would be caused by the I/O not completing its services in a sufficiently timely manner to allow full use of the processors. If processor use was very high and memory demand and availability were high, a memory allocation bottleneck or an overloaded processor would be indicated.

6.2.2 JCL. Figure 6-8 presents the JCL needed to run a total MUM reduction. The following points describe key features of the required JCL.

- 62K required for memory + 2K for SSAs
- 15K sysout requirement would vary depending on amount of data collected. This figure would be significantly higher if the Memory Map or Out of Core Report were produced.
- The DATA I* card is used to indicate the presence of data cards. All data cards must immediately follow this card. At least one data card must be present. That card will contain the word END and is used to signify the end of input data. The END card must be present even if no other data cards are desired.
- An additional 12K will be required to load the MUM reduction program but this 12K will be released immediately upon loading.

```
$   IDENT        1820251/30/3044,C702
$   SELECT       B29IDPX0/OBJECT/MUM
$   TAPE         01,X1D,,18897
$   LIMITS       999,62K,-4K,15K
$   DATA         I*
    DATA cards
    (at least an "END" card must be present)
$   ENDJOB
```

Figure 6-8. JCL to RUN MUDRP

Table 6-5 shows all the MUDRP file codes and their corresponding reports.

6.3 Outputs

In this section, a simple explanation of how each report was derived from the data is given. Subsection 6.1 discussed how the ranges and other options of each report may be modified to fit an individual installation.

Immediately prior to the output of the histograms, the user will find a printout containing processing information. Included in this information is the following:

- o Printout of all input options selected by user
- o Indication of multireel tapes that are being requested and have been mounted
- o Indication of the monitors that were active during data collection
- o Error messages - all error messages are either self-explanatory or else followed by the words "For Information Only." The latter messages are used by CCTC for future enhancements and as such can be ignored by the user.
- o If the time frame option was used, an indication of when the various time frames were reached.

6.3.1 MUM Title Page. The Memory Utilization Monitor (MUM) title page contains a summary of the systems configuration and activity over the measurement period (see figure 6-9). It displays the time the monitor was initiated and terminated, as well as identifying the system which was monitored and the tape number(s) containing the data. The configuration information is augmented by the amount of memory dedicated to the operating system itself, including that used by the memory allocation program. These figures will give the user a good idea of how much hard core space remains and could be used for SSA module hard core loading. If SSA cache is also configured the amount of memory being used for this feature is also listed. The version number should be 01-82.

Immediately following is a summary of the work processed over the measurement priod. The first set of lines provides information concerning the overhead generated by the actual data collection. The monitor name is given, its CPU time in seconds, and its overhead as a function of total processor power. The GMF executive overhead is separated from the actual monitors and is listed as "EXEC". The monitor "NAME" is an area of code within the Mass Store Monitor and even though listed separately it is also included under the monitor "MSM". The Monitor "FMS" is also an area of code within the Mass Store Monitor, but in this

Table 6-5. File Code for MUM Reports

20	Activity Resource Report, Special Job Reports
21	IDENT Report
27	Activity Abort Report
31	Plot 1 - (see table 6-1 for Plot Definition) (temporary file)
32	Plot 2 - (see table 6-1 for Plot Definition) (temporary file)
33	Plot 3 - (see table 6-1 for Plot Definition) (temporary file)
34	Excessive Resource Report
35	Plot 4 - (see table 6-1 for Plot Definition) (temporary file)
36	Used for outputting all plots
37	Used for outputting Out of Core Report, Memory Map, and Peripheral Allocator Report
42	Histograms
45	Out of Core Report (temporary file)
51	Memory Map Report with one file required for each 128K Memory configured (temporary file)
52	Memory Map Report with one file required for each 128K Memory configured (temporary file)
53	Memory Map Report with one file required for each 128K Memory configured (temporary file)
54	Memory Map Report with one file required for each 128K Memory configured (temporary file)
55	Memory Map Report with one file required for each 128K Memory configured (temporary file)
56	Memory Map Report with one file required for each 128K Memory configured (temporary file)
57	Memory Map Report with one file required for each 128K Memory configured (temporary file)
58	Memory Map Report with one file required for each 128K Memory configured (temporary file)
59	Demand List Report (temporary file)

```
****** T H E   M E M O R Y   U T I L I Z A T I O N   M O N I T O R ******
                              VERSION 01-82

MONITORING ON 79-05-04 STARTED AT 11:39:50 AND COMPLETED AT 13:19:56 FOR A TOTAL TIME OF 1.67 HOURS
                    ON SYSTEM OSCC2  RUNNING 6.4.1D OF TAPE D0002

                     THE SYSTEMS CONFIGURATION CONSISTED OF:

                          2 - 6680 CENTRAL PROCESSORS
                          2 - INPUT/OUTPUT MULTIPLEXORS
                              WITH 24 I/O CHANNELS
                        512 - 1024 WORD BLOCKS OF MEMORY
                         52 OF WHICH WERE USED BY THE HARD CORE SYSTEM ITSELF
                          3 OF WHICH WAS USED BY CALC
                         5K USED BY SSA CACHE (NOT HARD CORE)

             THE SYSTEM PROCESSED THE FOLLOWING OVER THE MEASUREMENT SESSION:

                  MONITOR        TIME(SECS)          % OVERHEAD
                   EXEC             100                 1.7
                   MUM               60                 1.0
                   CPU               40                  .7
                   IDLE              40                  .7
                   TOTAL                                4.1

                        175 ACTIVITIES WERE PROCESSED     AT A RATE/HOUR OF  104.89
                            OF THESE 50 WERE SYSTEM SCHEDULAR ACTS
                        125 ACTUAL ACTIVITIES WERE PROCESSED AT A RATE/HOUR OF 74.85

                        128 MOVES WERE PERFORMED          AT A RATE/HOUR OF   76.72
                        266 SWAPS WERE PERFORMED          AT A RATE/HOUR OF  159.44
                     201466 TIMES THE PROCESSORS WENT IDLE YIELDING A
                         20 % IDLENESS OF THE PROCESSORS
          THE FIRST  PROCESSOR WENT IDLE 122479 TIMES, YIELDING 23 % IDLENESS
          THE SECOND PROCESSOR WENT IDLE  78987 TIMES, YIELDING 17 % IDLENESS

     THE MEMORY ALLOCATOR WAS CALLED      1907 TIMES -       0 OF WHICH RESULTED IN NO STATE CHANGE

  THE TOTAL CPU TIME IN SECS WAS   6991   THE TOTAL IO TIME IN SECS WAS   15662   CPU/IO RATIO IS  0.446373
          WEIGHTED MEMORY SURPLUS IN K WORDS WAS    46
          WEIGHTED MEMORY SHORT-FALL IN K WORDS WAS 50 INCLUDES CALC AND PALC QUEUES
```

Figure 6-9. MUM Title Page Report - Idle Monitor Active

case it has not been included under the monitor "MSM". These two special areas of code, within subroutine T7 (connect trace processing), are considered to be high usage areas and as such consume significant processing resources. In order to determine the true overhead of these areas, so that future code optimization can be considered, these areas are being reported separately.

Monitor "CM" in this report describes the processor overhead of subroutine T4 (terminate processing) and subroutine T22 (start I/O processing). Monitor "MSM" in this report describes the processor overhead of subroutine T7 (connect processing). Therefore, if the Channel Monitor was active, but the Mass Store Monitor was not, this report will still list both "CM" and "MSM" as contributing to the processor overhead. The total Channel Monitor overhead will be found by adding the overhead of the "CM" monitor, to the overhead of the "MSM" monitor, to the overhead of the "FMS" monitor.

If both the Channel Monitor and Mass Store Monitor were active, then the combined overhead of both monitors can be found as the sum of "MSM" + "CM" + "FMS".

For purposes of this report % overhead is computed as

$$\frac{\text{(CPUTIME used by monitor)}}{\text{(Total Elapsed Time) x (number of Processors)}}$$

Following this are several lines describing the work performed during the monitoring session. These lines are self-explanatory.

If a termination record is not processed, either because the monitor aborted before a termination record could be written or else time frames were used, the lines describing GMC overhead will not be printed.

The number of times a processor went idle is derived from the idle processor traces captured by the IDLEM, with the percentage of processor idle also being gathered by the collection of idle state information. This is shown system-wide (i.e., for all the central processors and then individually for each processor). This information will not be present if the IDLEM was not active or if its output reports have been disabled by a data card option (see figure 6-10).

The number of memory allocator calls, as counted by the monitor, is shown. This much less than the number of calls to the multitude of SSA modules used by the Core Allocator and consists only of those that may have altered the memory state of the system. The second figure shows how many times a memory state change might have taken place and did not. This could be caused by no allocation being possible or by a call to the allocator pertaining to a matter other than allocation (i.e., a console message).

```
****** T H E   M E M O R Y   U T I L I Z A T I O N   M O N I T O R ******
                              VERSION 01-82

MONITORING ON 80-12-15 STARTED AT 12:39:46 AND COMPLETED AT 19:29:06 FOR A TOTAL TIME OF 6.82 HOURS
                  ON SYSTEM NMCC2  RUNNING W64000 OF TAPE D0001

                     THE SYSTEMS CONFIGURATION CONSISTED OF:

                          2 - 6680 CENTRAL PROCESSORS
                          2 - INPUT/OUTPUT MULTIPLEXORS
                              WITH 16 I/O CHANNELS
                        512 - 1024 WORD BLOCKS OF MEMORY
                         52 OF WHICH WERE USED BY THE HARD CORE SYSTEM ITSELF
                          3 OF WHICH WAS USED BY CALC
                         5K USED BY SSA CACHE (NOT HARD CORE)

              THE SYSTEM PROCESSED THE FOLLOWING OVER THE MEASUREMENT SESSION:

                    MONITOR         TIME(SEC)         % OVERHEAD
                     EXEC              300               1.2
                     MUM               200                .8
                     TOTAL                               2.0

                        1033 ACTIVITIES WERE PROCESSED     AT A RATE/HOUR OF  151.41
                             OF THESE 33 WERE SYSTEM SCHEDULAR ACTS
                        1000 ACTUAL ACTIVITIES WERE PROCESSED AT A RATE/HOUR OF 146.63

                        1660 MOVES WERE PERFORMED          AT A RATE/HOUR OF  243.31
                        6363 SWAPS WERE PERFORMED          AT A RATE/HOUR OF  932.66
                      IDLE MONITOR WAS NOT ACTIVE OR WAS TURNED OFF

THE MEMORY ALLOCATOR WAS CALLED    23409 TIMES -      14 OF WHICH RESULTED IN NO STATE CHANGE

THE TOTAL CPU TIME IN SECS WAS  31022   THE TOTAL IO TIME IN SECS WAS   61341   CPU/IO RATIO IS  0.505735
      WEIGHTED MEMORY SHORT-FALL IN K WORDS WAS 101 INCLUDES ONLY CALC QUEUE
      WEIGHTED MEMORY SHORT-FALL IN K WORDS WAS 150 INCLUDES CALC AND PALC QUEUES
```

Figure 6-10. MUM Title Page Report - Idle Monitor Off

The next line printed out is the Total CPU and I/O times in seconds and the ratio of CPU to IO time. This figure gives the user an idea of whether the workload processed by the system is I/O or CPU dominant. It should be noted that these numbers are the amount of CPU and I/O time generated during the measurement period.

The next two lines give an indication of whether the system has a surplus or shortfall of memory the weighted figure is calcualted by using the following formula:

$$W = \frac{\sum_{i=1}^{N} \left(\text{memory available} - \text{demand for memory} \right) * \left(T_{i+1} - T_i \right)}{\text{TOTAL TIME}}$$

Where i = calls to the core allocator

$T_{i+1} - T_i$ - length of time over which memory availability was in this state.

If W comes out positive, there is a core surplus and if W comes out negative, there is a core shortfall. In the first line, the demand for memory is taken only from the Core Allocator's queue. In the second line the demand for memory is taken from the demand in both the Core Allocator and Peripheral Allocator queues. The Peripheral Allocator's queue consists of the memory demand that is currently being processed by the Peripheral Allocator and has not yet reached the Core Allocator. The Peripheral Allocator will stop transferring jobs to the Core Allocator when the Core Allocator's queue reaches a predefined length. This second figure presents a truer picture of memory availability. Jobs from the Peripheral Allocator are only included if they have been completely processed by the Peripheral Allocator. These figures present a good first indication of whether or not availability of memory is a system constraint.

6.3.2 System Program Usage. The report immediately following the title page provides an overview of the system program load on the memory subsystem. The data presented consists of the following.

- $\dfrac{\text{Total Memory Time for This System Program * 100}}{\text{Memory Time for all Programs}}$

This figure would indicate what percentage of the total memory time was used by this program.

- Percentage of the Elapsed Time in Memory

- $\dfrac{\text{Total Size Time Product for this System Program * 100}}{\text{Total Size Time Product for all Programs}}$

This figure would indicate what percentage of the total size time product was used by this program. The size-time product of a job is an attempt to determine the memory effect of a job based not only on its size, but on the length of time that it runs. A 20K job that runs for three hours might be more detrimental to a system than a 60K job that runs ten minutes.

o $\dfrac{\text{Total Size Time Product for this System Program * 100}}{\text{Total Size Time Product Available to System}}$

Where Total Size Time Product Available to System = (The Elapsed Run Time) * (Total Allocatable Memory)

The next two figures are weighted memory sizes for this program. The first figure is the weighted memory size of this program while it is in memory. Therefore, if TSS was in memory during three different time periods for 1/2 hour, 3/4 hour, and one hour, and during these periods its memory size was 40K, 100K, 180K respectively, its weighted in memory size would be calculated as follows:

$$\text{Weighted (IN)} = \frac{(40)*(.5)+(100)*(.75)+(180)*(1)}{2.25} = \frac{275}{2.25} = 122\text{K}$$

Had the calculation not been weighted by time the average size of TSS would have been:

$$\frac{(40)+(100)+(180)}{3} = 73\text{K}$$

In the above calculation, the report would be stating that the amount of memory being taken away from the system, by TSS, was 122K. However, what if TSS was swapped for 50 percent of the total elapsed time. Then TSS really did not take 122K from the system, but rather only 61K. The second weighted figure takes into account the total time the program was actually in memory.

The final figure is the number of times this program was swapped.

In addition to the standard system programs, any jobs requested by the user, to be considered as system jobs, also appear in this report. In figure 6-11 we see six user requested jobs appearing on the report. The user had actually requested nine jobs to be considered as system jobs, but three of those jobs never appeared. In a system using multicopies of TSS only TS1 (prog #5) will appear in this report. Other copies of TSS must be requested by user input option "MASTER".

6.3.3 MUM Reports. The following paragraphs describe the reports output by MUM.

Report numbers 1-50 are all presented in a histogram format (see figure 6-12). At the top of the report, the system name, as well as the time and date of data collection, are given. This is followed by the title

THE SYSTEM PROGRAM USAGE OF MEMORY WAS:

PROGRAM	% USED OF MEMORY USE TIME	% OF TIME IN MEMORY	% USED OF SIZE-TIME USED OF MEMORY	% USED OF SIZE-TIME AVAILABLE	WEIGHTED IN/TTM	# SWAPS
(001) GMF MONITOR	7%	100%	5%	5%	23/ 24	0
(002) PERIPHERAL ALLOCATOR	5%	71%	2%	2%	17/ 12	988
(003) GENERAL SYSTEM OUTPUT	6%	93%	6%	5%	26/ 25	58
(004) REMOTE INPUT	2%	35%	1%	1%	16/ 5	415
(005) TIME-SHARING EXECUTIVE	7%	100%	31%	28%	129/129	0
(006) TEST AND DIAGNOSTICS	0%	1%	0%	0%	6/ 0	0
(010) LOG ON - SECURITY	2%	38%	1%	0%	11/ 4	292
(011) FILE MANAGEMENT SYSTEM	0%	12%	0%	0%	9/ 1	0
(012) WW NETWORK CONTROL (NCP)	6%	88%	5%	5%	27/ 24	79
(013) WW TELNET	4%	65%	2%	2%	16/ 10	150
(014) WW T2EXEC	3%	47%	3%	3%	28/ 13	233
(015) WW TLCF	2%	38%	1%	1%	16/ 6	54
(016) DMS PROCEDURES (DMTEX)	0%	0%	0%	0%	4/ 0	1
SPEC 1 HEALS	1%	21%	0%	0%	7/ 1	150
SPEC 4 NACE	3%	50%	2%	2%	18/ 9	1652
SPEC 6 VIDEO	7%	99%	1%	1%	6/ 5	2
SPEC 7 LGEN	7%	99%	4%	3%	17/ 16	4
SPEC 8 NEWRM	0%	8%	0%	0%	3/ 0	0
SPEC 9 DMSTA	5%	79%	1%	1%	8/ 6	717
				TOTAL	387/290	

Figure 6-11. System Program Load

```
                DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 12:39:46 ON 80-12-15

                              THE # OF USER ACTIVITIES IN MEMORY

INDIV.  CUMUL.   CUMUL.   INDIV.  NUMBER            PERCENT OF OCCURRENCE                          REPORT
NUMBER  NUMBER    PRC      PRC      IN     00   05   10   15   20   25   30   35   40   45   50       15
                                           I....I....I....I....I....I....I....I....I....I....I
  229     229    0.978    0.978   0-   0   IX
 1779    2008    8.578    7.599   1-   1   IXXXXXXXX
 4063    6071   25.933   17.356   2-   2   IXXXXXXXXXXXXXXXXX
 6597   12668   54.114   28.180   3-   3   IXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 7062   19730   84.280   30.167   4-   4   IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
 2899   22629   96.664   12.384   5-   5   IXXXXXXXXXXXX
  633   23262   99.368    2.704   6-   6   IXXX
  134   23396   99.940    0.572   7-   7   IX
   14   23410  100.000    0.060   8-   8   I

23410 ENTRIES TOTAL    AVERAGE =  3.30145    VARIANCE =  1.622    STANDARD DEVIATION =            1.273
```

Figure 6-12. Standard Histogram Report

line of the histogram. Column number 1 indicates the number of occurrences of a given event, with column number 5 describing the event. In figure 6-12, we find that 229 times there were 0 user activities in memory, while 2899 times there were five activities in memory. Column number 2 is simply a running total of column number 1. Therefore, the second line in column number 2 (2008) is merely a running total of the first two lines of column number 1 (229 + 1779). The fourth column is the percentage of all activities which will fall into that line of the report showed two user activities in memory. For example, 4063 entries out of a total 23410 entries. This results in a 17.35 percentage figure. This means that 17.35% of all measurements (4063/23410) showed 2 activities being in memory. Column number 3 is simply a running total of column number 4. It presents the percentage of measurements which will fall into a given line, or earlier line. For example, 25.93% of all measurements showed the number of activities in memory to be 2 or less. There is a graphic display of these measurements presented to the right of the fifth column. At the bottom of the report, summary information is provided and is calculated in the standard statistical manner.

In figure 6-13, we see a similar histogram report. As displayed by column 5, we find that each line of the histogram represents a range of values, with an interval size of 200. This interval size can be modified by the user. The lowest value in this histogram is 0 (modifiable by the user) and the size of the histogram defaults to 45 lines (also modifiable by the user). Actually for this run, the lowest value recorded was 42. Since we can output only 45 lines and each line represents a range of values of 200, the largest value that could be reported would be 9,000 (200 X 45). If a measurement falls outside this maximum value, it is reported as an out-of-range value. In figure 6-13, we find the 21 measurements exceeded 9,000. The average of these 21 measurements was 20188.48. The first line of the summary includes all measurements that were taken. Therefore, 21 out of 79 entries (26 percent) of all measurements were out of range. The average of all measurements taken was 5953.62, while the average of the in-range measurements, (all out of range values are eliminated) was 799.62.

6.3.3.1 <u>Report 1 - Memory Demand Sizes of New Activities in 1K Word Blocks</u>. This report shows the demand size, in 1K-word blocks, of each individual user activity as it was first seen by the memory allocator. The demand sizes are presented to the allocator by the Peripheral Allocator. This is a good measure of the memory demand load of a systems operation and can be used to set System Scheduler classes to correctly balance the load across varying memory size jobs. In this type of report, the distribution shows the percentage of activities which had a particular memory size. For this report, an entry is made for each new user activity demand at each allocator call. See Report 10 for an explanation of user vs. system activity.

6.3.3.2 <u>Report 2 - The Memory Demand Size of All Demand Types</u>. This report contains the information in Report 1, with the addition of all other individual demand types. These include activities that are swapped or involved in a memory compaction procedure. This report should be similar to Report 1, unless a great amount of GEMORE, GERLEC, or swap

```
                    DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 18:50:03 ON 81-03-13

                        THE ELAPSED DURATION OF USER ACT IN TENTHS OF A SECOND

INDIV.  CUMUL.  CUMUL.  INDIV.  TENTHS                  PERCENT OF OCCURRENCE                          REPORT
NUMBER  NUMBER   PRC     PRC    SECOND  00   05   10   15   20   25   30   35   40   45   50            20
                                        I....I....I....I....I....I....I....I....I....I....I
  22      22   27.848  27.848   42- 199 IXXXXXXXXXXXXXXXXXXXXXXXXXXXX
  14      36   45.570  17.722  200- 399 IXXXXXXXXXXXXXXXXXX
   5      41   51.899   6.329  400- 599 IXXXXXX
   2      43   54.430   2.532  600- 799 IXXX
   1      44   55.696   1.266  800- 999 IX
   0      44   55.696   0.    1000-1199 I
   1      45   56.962   1.266 1200-1399 IX
   2      47   59.494   2.532 1400-1599 IXXX
   1      48   60.759   1.266 1600-1799 IX
   0      48   60.759   0.    1800-1999 I
   1      49   62.025   1.266 2000-2199 IX
   3      52   65.823   3.797 2200-2399 IXXXX
   0      52   65.823   0.    2400-2599 I
   0      52   65.823   0.    2600-2799 I
   1      53   67.089   1.266 2800-2999 IX
   1      54   68.354   1.266 3000-3199 IX
   1      55   69.620   1.266 3200-3399 IX
   0      55   69.620   0.    3400-3599 I
   2      57   72.152   2.532 3600-3799 IXXX
   0      57   72.152   0.    3800-3999 I
   0      57   72.152   0.    4000-4199 I
   1      58   73.418   1.266 4200-4399 IX

79 ENTRIES TOTAL     AVERAGE = 5953.62024     VARIANCE = 04446990.000     STANDARD DEVIATION = 10219.931
        21(26%) OUT OF RANGE    AVERAGE FOR THESE =     20188.48     IN RANGE AVERAGE =     799.62
```

Figure 6-13. Out-of-Range Histogram

operations are performed by the users load. This would alter the memory size demands from that seen by the allocator at the initial request. For this report, an entry is made for each activity with an outstanding demand for each allocator call. Jobs with an urgency of 0 are not counted.

6.3.3.3 Report 3 - The Total Memory Demand Outstanding. This report shows the sum of demand for all activities in the system including outstanding GEMOREs. It is a distribution of memory demand that is not satisfied, across the measurement session. It should be remembered that all data is collected at the Core Allocator and does not represent the full system load. Portions of the load may be held in the System Scheduler and the Peripheral Allocator.

For this report, an entry is made at each allocator call.

6.3.3.4 Report 4 - The Demand That Was Outstanding When a Processor Went Idle. This report is the same as Report 3, except that an entry is made only if a processor has gone idle since the last allocator call. If a large demand should be outstanding during processor idleness, a system bottleneck may be present. In this case, memory is probably fully utilized (i.e., demand cannot be satisfied), but the jobs that are occupying memory are not using the processor, (i.e., a processor has gone idle). This is a good sign of an I/O backlog. Several of the CPU reports described in chapter 11 can be used to verify this hypothesis. IDLEM data is used to produce this report.

6.3.3.5 Report 5 - The Total Amount of Available Memory. The total amount of available memory is a key indicator of the system memory utilization. If this amount is continually low, the memory is being fully utilized and possibly in need of expansion. A continually high amount may indicate another system bottleneck or an excess of memory. This report, when used in conjunction with Reports 3, 4, and 6 should give a good first-level indication of system memory utilization. It should be noted that the availability shown here exists in all quadrants. The availability is the sum of any and all "holes" in the system and does not mean that this memory is contiguously available.

The average value reported in this report minus the average value reported in report 3 will give a good feel for memory surplus or shortfall. A positive result will indicate a surplus while a negative result will indicate a shortfall. The MUM heading report also gives a surplus/shortfall indicator.

For this report, an entry is made for each allocator call.

6.3.3.6 Report 6 - The Memory Available When a Processor Went Idle. The previous report is repeated with the additional restraint that a processor has gone idle since the last allocator call. This aids in identifying either a bottleneck or a lightly loaded system.

For this report, an entry is made at each allocator call that had a processor go idle since the last allocator call. IDLEM data is used to produce this report. This report will not be produced if IDLEM was not active or the IDLEM Reports have been disabled via user input command.

6.3.3.7 Report 7 - The Time Corrected Total Demand Outstanding. See report 16 for an explanation of time correction. The time corrected total demand is the sum of all requests for memory known to the alloca-tor as indicated in Report 3. Jobs with urgency 0 are not counted.

6.3.3.8 Report 8 - The Time-Corrected Memory Available. See Report 16 for an explanation of time correction. This report reflects the time-corrected amount of total memory available as indicated in Report 5.

6.3.3.9 Report 9 - The Number of Activities Waiting for Memory in Allocator Queue. This report identifies the depth of the allocator demand queue and includes all activities that are waiting for memory allocation. It aids in determining if too many or too few jobs are getting to the Core Allocator from the Peripheral Allocator. For this report, an entry is made at each allocator call.

6.3.3.10 Report 10 - The Number of User Activities Waiting Memory in Allocator Queue. This report is the same as Report 9 except that it only counts those activities of a slave job as identified by their program number (program number 15 or greater). In order to change this program number test the user should see Input Action FSTSLV. In addition, the user may specify up to ten additional programs that he wants considered as system programs, even though their program number exceeds 15. The user should see Input Action MASTER in order to select this option. This report indicates the "user" work waiting allocation. For this report, an entry is made on each allocator call.

6.3.3.11 Report 11 - The Time-Corrected Number of Activities Waiting Memory. See Report 16 for an explanation of time correction. This report indicates the time-corrected number of activities waiting memory as in Report 9.

6.3.3.12 Report 12 - The Time-Corrected Number of User Activities Waiting Memory. See Report 16 for an explanation of time correction. This report indicates the time-corrected number of user jobs waiting memory in the allocators queue as in Report 10. See Report 10 for additional user options.

6.3.3.13 Report 13 - The Number of Activities Waiting Memory When a Processor Went Idle. Report 9 is the basis for this report, with the additional criteria that a processor must have gone idle since the last allocator call. An entry is made for each allocation where a processor has gone idle since the last call. IDLEM data is used to produce this report. This report will not be produced if IDLEM is not active or the IDLEM reports were disabled via user input commands.

6.3.3.14 Report 14 - The Number of Activities Residing in Memory. This report represents the number of activities allocated memory. It indicates the multiprogramming depth the system is obtaining. It is probably an upper level since an activity is allocated memory prior to and past actual usage. For this report, an entry is made for each allocator call.

6.3.3.15 Report 15 - The Number of User Activities in Memory. The activities shown in this report are those that are in memory and have a program number greater than or equal to 15. These are user programs. For this report, an entry is made at each allocator call. See Report 10 for additional user options in defining system jobs and user jobs.

6.3.3.16 Report 16 - The Time-Corrected Number of Activities in Memory. This report presents the same information as in Report 14. The number of entries at each allocator call is determined by the time since the last allocator call. The result is a simulation of a uniform sample rate of allocator calls. Therefore, the noncorrected reports display the distributions as seen by the allocator itself. The time corrected reports present the time weighted distributions. As an example assume that three measurements are taken. It is found that six activities are in memory for two minutes, 20 activities for five minutes, and eight activities for one minute. The average number of activities in memory is (6+20+8)/3=11. If we correct for time however, we get ((6)*(2)+(8)+(20)*(5))/8=100/8=12.5 activities in memory. The division of 8 was the total time (5+2+1) spent collecting data. All of the time-corrected reports are of the same nature.

6.3.3.17 Report 17 - The Time-Corrected Number of User Activities in Memory. This report indicates the time-corrected number of user jobs with allocated memory as in Report 15. See Report 10 for additional user options in defining system jobs and user jobs. See Report 16 for a definition of Time Correction.

6.3.3.18 Report 18 - The Number of Activities in Memory When a Processor Went Idle. This report indicates the total number of activities with allocated memory when a processor went idle. This report can show an I/O bottleneck if the multiprogramming depth is high but there is no work for a processor to perform. For this report, an entry is made on each allocator call for which a processor went idle since the last call. IDLEM data is used to produce this report. This report will not be produced if IDLEM is not active or if IDLEM reports have been disabled by user input options.

6.3.3.19 Report 19 - The Ratio of User Activity Duration Versus Its Memory Use Time. This report indicates the ratio of total elapsed time (Report 20) over the total allocated memory time (Report 21). This shows how activity run time is stretched due to resource contention.

For this report, an entry is made for each user activity that terminates. See Report 10 for an explanation of user vs. system activities.

6.3.3.20 Report 20 - The Elapsed Duration of User Activity in 10ths of a Second. This report presents the clock time that the allocator knew of a user activity's existence, measured from its first memory demand to its termination. This includes all time spent in a GEWAKE, in memory, and swapped.

For this report, an entry is made for each user activity that terminates. See Report 10 for an explanation of user vs. system activities.

6.3.3.21 Report 21 - The Total Elapsed Time a User Activity Was in Memory. This report shows the duration of elapsed clock time each user activity had memory allocated to it. It helps describe the system workload requirements.

For this report, an entry is made for each user activity that terminates. See Report 10 for an explanation of user vs. system activities.

6.3.3.22 Report 22 - The GEMORE Service or Denial Time - 1/10 Second, Elapsed. The time from a GEMORE request until the activity is allocated the extra memory, swapped to achieve the additional memory, or denied the memory is displayed in this report.

For this report, an entry is made for each activity whose GEMORE request is no longer present.

6.3.3.23 Report 23 - The Request Size of GEMOREs. All GEMORE requests are shown in this report with the displayed size in 1K blocks.

For this report, an entry is made for each GEMORE request.

6.3.3.24 Report 24 - Not Output. Report 24 is used within the data reduction as a buffer for the two levels of information necessary for Report 25 and is not an available report for display.

6.3.3.25 Report 25 - The Memory Demand Size Versus the Memory Wait Time. This report is the only dual-axis (averaged) histogram and displays the relationship of memory demand size and the wait time for its allocation. This report will show if the allocator or workload is biased in its services. The vertical axis represents a single-axis histogram and contains the memory demand sizes. The information to the left of the sizes is a count of the entires in each interval. The horizontal axis displays the averaged wait time for all the entires of a particular size interval. This is in contrast to the single-axis histogram which shows merely the occurrence distribution. The scale of this axis is determined from the data; the lowest and highest scale values represent the shortest and longest averaged wait times that have occurred. The time interval of each X is given as the DELTA on the report and the actual averages obtained for each entry are displayed under AVERAGE.

The histogram is derived by accumulating the sum of the wait times for each interval size and dividing by the total number of entries in that interval. This supplies the average memory wait time for that interval of demand size. The statistics shown below the histogram pertain to

the vertical axis followed by the statistics of the average wait times of the horizontal axis. The minimum and maximum times shown are those for all wait times and are not the averages.

For this report, an entry is made whenever an allocation of memory is made (refer to figure 6-14).

6.3.3.26 Reports 26 through 31 - The Elapsed Time of a Busy State of the Processors. These reports present the elapsed clock time between the idle states of each individual processor. The reports supply an indication of how each processor is utilized versus the others in the system.

For these reports, an entry is made at each idle state of a processor. IDLEM data is used to produce these reports. These reports will not be produced if the IDLEM was not active or if the IDLEM reports have been disabled by user input option.

6.3.3.27 Report 32 - The Elapsed Time of a Busy State of Processors. The elapsed clock time between idle states of all processors is presented in this report.

For this report, an entry is made for each processor idle state. IDLEM data is used to produce this report.

6.3.3.28 Report 33 - Elapsed Time Between Allocator Calls in 1/100 of a Second. This report shows the elapsed clock time between calls to the allocator and shows if the allocator is receiving sufficient service.

For this report, an entry is made on each allocator call.

6.3.3.29 Report 34 - The I/O Time Charged per User Activity in Seconds. This report indicates the I/O time charged to each user activity.

For this report, an entry is made for each user activity that terminates.

6.3.3.30 Report 35 - The CP Time Charged per User Activity in Seconds. This report presents the CP time charged to each user activity. For this report, an entry is made for each user activity that terminates.

Reports 34 and 35 report the total CPU and I/O times used by a user activity while the monitor was active. These histograms are not generated for programs with program numbers less than 15 (i.e., system programs). See Report 10 for additional user options in defining system activities and user activities.

6.3.3.31 Report 36 - The Number of Times a User Activity Was Swapped. This report shows the swap count per user activity. The total number of swaps a user activity incurs is the user argument, as counted by the monitor. See Report 10 for additional user options in defining system activities and user activities.

For this report, an entry is made for each user activity that terminates.

```
                 DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 12:39:46 ON 80-12-15

                   THE MEMORY DEMAND SIZE VERSUS THE AVERAGE MEMORY WAIT TIME

INDIV.   CUMUL.   CUMUL.   INDIV.   DEMAND  THE AVERAGE ELAPSED WAIT TIME IN TENTHS OF A SECOND   DELTA    REPORT
NUMBER   NUMBER    PRC      PRC      SIZE        0.                     780.                1559.  31.184     25
                                             :.........I.........I.... ....I.........I.........: AVERAGE
  563      563    7.211    7.211    1-   7  IXXXXXX                                              160.950
 1319     1882   24.107   16.895    8-  11  IX                                                    50.215
  259     2141   27.424    3.318   12-  15  IXXXX                                                134.718
 3826     5967   76.431   49.007   16-  19  IX                                                    38.229
   62     6029   77.226    0.794   20-  23  IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX     1428.613
  348     6377   81.683    4.458   24-  27  IXXX                                                 103.557
  192     6569   84.142    2.459   28-  31  IXXXX                                                152.443
  361     6930   88.766    4.624   32-  35  IXXXXXXXXXXXXXXXXXX                                  546.352
  281     7211   92.366    3.599   36-  39  IXXXXXXXXXXXXX                                       434.676
  150     7361   94.287    1.921   40-  43  IXXXXXXXXXX                                          315.520
  165     7526   96.401    2.113   44-  47  IXXXXXXXXXXXXXXXXXXXX                                619.745
   37     7563   96.875    0.474   48-  51  IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX           1214.270
   17     7580   97.092    0.218   52-  55  IXXXXXXXXXXXXXXXXXXX                                 585.294
  151     7731   99.027    1.934   56-  59  IXXXXXXXXXXXXXXXXXXXXXXXXXX                          806.338
   12     7743   99.180    0.154   60-  63  IXXXXX                                               158.000
   56     7799   99.898    0.717   64-  67  IXXXXXX                                              195.375
    5     7804   99.962    0.064   68-  71  IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX 1559.200
    2     7806   99.987    0.026   72-  75  IX                                                    35.500
    0     7806   99.987    0.      76-  79  I                                                      0.
    0     7806   99.987    0.      80-  83  I                                                      0.
    1     7807  100.000    0.013   84-  87  I                                                      0.

 7807 ENTRIES TOTAL     AVERAGE =  19.60036     VARIANCE =  144.900     STANDARD DEVIATION =  12.037

     MINIMUM VALUE =  1.000     MAXIMUM VALUE =  87.000

FOR THE HORIZONTAL AXIS-WEIGHTED AVERAGE=  148.35225     VARIANCE =  518188.184     STANDARD DEVIATION=  719.853

     MINIMUM VALUE =  0.     MAXIMUM VALUE =  1559.200     OF THE WAIT TIMES
```

Figure 6-14. Report 25

6.3.3.32 Report 37 - The Total Elapsed Time a User Activity Was Swapped. This report indicates the total time a user activity was inactive due to a swap. After each swap is completed, an accumulator is updated, and if an activity is terminated, an entry is made to this report. See Report 10 for additional user options in defining system activities and user activities.

6.3.3.33 Report 38 - The Number of Times a System Activity Was Swapped. This report is the same as Report 34 except for system activities. See Report 10 for additional user options in defining system activities and user activities.

6.3.3.34 Report 39 - The Total Elapsed Time a System Activity Was Swapped. This report is the same as Report 35 except for system activities. See Report 10 for additional user options in defining system activities and user activities.

6.3.3.35 Report 40 - Number of Extra Activities That Might Fit in Memory Using Compaction. This report shows how memory might have been used more optimally. It takes the total amount of available memory (displayed in Report 5) and attempts to fit in those activities waiting memory. If an activity fits, the memory available is decreased, and the next activity is tried. If an activity does not fully fit, the next activity is tried. This continues until all available memory is used or until all the activities waiting have been tried. The search starts at the first waiting program and progresses serially down the program numbers of those waiting. This search ignores the actual size of "holes" or quadrant-crossing and is not necessarily obtainable or optimal. For this report, an entry is made at each allocator call.

6.3.3.36 Report 41 - Number of Extra Activities That Might Fit Memory Without Compaction. This report is the same type as Report 40. In this case, activities are fit into existing holes and are ordered by urgency. The search progresses down the activities serially, beginning at the highest urgency activity. This histogram presents a good picture of how well the core allocator is performing its function.

For this report, an entry is made at each allocator call.

6.3.3.37 Report 42 - The Percent of Size-Time Product Used by a User Activity. This report shows the percentage of user each activities' size-time product over its run-time duration. An entry is made for each user activity that terminates. See Report 10 for an explanation of user and system activities.

6.3.3.38 Report 43 through 49 - The Length of Idle State in the Processors. The elapsed clock time of an idle state is given in these reports for each individual processor and also as an average for all processors. They supply an indication of how each processor was utilized versus the others in the system. They also provide information on how busy the processors are. These reports should be used in conjunction with Reports 26 through 32.

IDLEM data is used to produce these reports. These reports will not be produced if IDLEM was not active or if the IDLEM reports have been disabled by user input command.

6.3.3.39 Report 50 - Original Allocation Time for User Memory in 1/10 Second. This report gives the time each user activity waited for its original allocation of memory. See Report 10 for an explanation of user and system activities.

6.3.3.40 Report 51 - The Time-Corrected Percent of Assigned Memory Used. This report gives the time-corrected percentage of slave memory used over the monitoring period. See Report 16 for a definition of Time Correction.

6.3.4 Activity Resource Usage Report. For each activity known to the monitor, a detailed Resource Usage Report is made upon termination of the activity. The report is ordered by termination time sequence, and the resource usage is that known to the system at the last allocator call (refer to figure 6-15).

Each activity is displayed via the SNUMB and activity number followed by the CP and I/O charge times expressed in milliseconds. This the CP and I/O times generated during the monitoring session. The size-time product is the total K words times the microseconds of allocation time, which gives a better expression for the memory used by the job than the size of the job. The minimum and maximum core requirements of the job are then shown, including the activity Slave Service Areas (SSAs) as well as slave size.

The elapsed time, in hours, an activity was known to the allocator is followed by the number of times the job size changed for any reason. The wasted core column is calculated from the job Slave Prefix Area (SPA) word 37 octal. This is filled by the System Loader and may not be valid for all job types (i.e., an H* file is not loaded in the normal system load manner). This column is shown in order to help locate users that do not have the $LIMITS card set correctly for the memory being used. If the user appears to be requesting excessive core on his $LIMITS card, he may be using this extra space as a spare buffer area. If this figure shows an excessive misuse of the $LIMITS card, the user should be contacted and questioned.

The next two columns provide a count of the total number of swaps and moves incurred by the activity. The final columns of the entry gives memory allocation time, wait time, swap time, memory time, and GEWAKE time, all in tenths of a second for each activity. An entry will be made in this report for every activity of a job, when the activity completes. Upon termination of the monitor, the resource usage of all activities known to the allocator will be reported, including system jobs. This output follows a full line of asterisks to denote that no termination records were found for these activities.

```
           COLLECTED ON SYSTEM NMCC2 ON 80-12-15 AT TIME 12:39
ACTIVITY RESOURCE USAGE REPORT - REPORTED PER ACT SIZE   ELAPSED   SIZE WASTED                     TIME(.1 SEC) SPENT IN
SNUMB-ACT  CPU & IO TIME   (MS)  SIZE-TIME PROD  MIN   MAX   TIME   CHANGE  CORE  SWAPS  MOVES  ALLOC   SWAP  MEMORY  GEWAKE
7332T-  0      44          108    1.5829E 08     31    31   0.003      0      0     0      0      51      0      55       0
7329T-  0   12077        29043    2.6766E 09     32    32   0.023      0      0     0      0       0      0     837       0
$GENB-  0     275         1003    1.7747E 07     11    11   0.001      0      0     0      0       2      0      16       0
7339T-  0    1300         2483    1.5904E 08     40    40   0.008      0      0     0      0     234      0      41       0
7348T-  0    1421         2646    1.3063E 08     31    31   0.042      0      0     0      0    1463      0      43       0
7338T-  1     991         2761    8.1595E 07     12    12   0.016      0      2     0      0     512      0      67       0
7338T-  2    2267         4284    2.6228E 08     25    36   0.003      2      0     0      2      15      0      83       0
7338T-  3    2761         4297    3.7449E 08     45    56   0.006      2      0     0      2     131      0      83       0
7354T-  0    1360         2909    2.1781E 08     40    40   0.002      0      0     0      0       5      0      55       0
7338T-  4    1766         3848    3.5940E 08     42    53   0.005      1      6     0      1     110      0      76       0
XXXXX-  0    2388        13991    4.8413E 08     11    11   0.016      0      0     0      0     146      0     440       0


FOLLOWING INFO MAY BE INCOMPLETE DUE TO LOST, DATA, NO EOF, OR ACTIVITY WAS ACTIVE WHEN MONITOR ENDED.

    SYSTEM SCHEDULER CPU TIME, IO TIME AND SIZE-TIME PRODUCT ARE 43122911 129261145                   0.19D 12
$PALC-  1   615091     2394913    2.9917E 11     17    17   6.822      0      0   988    108           0  17546  175982   52077
SYSCT-  0   626346    21551415    6.2101E 11     27    27   6.822      0      0    58    119           0   1877  230004   13728
$RGIN-  0    52768      167826    1.3920E 11     16    16   6.822      0      0   415     28           0  34039   87000  124567
-TSS--  1 12163737    13709653    3.1906E 12     77   187   6.822     58      0     0      0           0      0  245610       0
LOGON-  0    91433       59898    1.0459E 11     11    11   6.822      0      0   292     23           0  10302   95078  140228
FSYS -  0        0          90    2.7697E 10      9     9   6.822      0      0     0      0           0      0   30774  214835
NCP  -  1   387705       72254    5.9289E 11     26    28   6.822      2      0    79     43           0   3452  216492   25664
TELNE-  1   231955       27456    2.5972E 11     16    17   6.822      2      0   150     22           0   5644  161220   78745
FTS  -  1   216277      488796    1.7443E 11     24    51   4.732    176      0   191    111           9   3053   55649  111637
TLCF -  1    35090       32496    1.5089E 11     16    16   6.822      0      0    54     44           0   1839   94307  149462
DMTEX-  1        0          60    7.6714E 06      4     4   6.822      0      0     1      0           0     13      19  245577
DMSTA-  1   450328     1113536    1.5680E 11      8     8   6.822      0      0   717     76           0  13430  195994   36182
VIDEO-  1   116630         496    1.4735E 11      6     6   6.822      0      0     2      0           0     21  245588       0
7871T-  2   505393      384600    6.4366E 10     38    38   0.645      0      0    45      9          26   6263   16938       0
WAITL-999        0           0    0.             58    58   0.175      0      0     0      0        6291      0       0       0
$GENB-  0   673795     2019705    1.9096E 11   ** MEMORY USE TIME * 8.6242E 09
```

Figure 6-15. Activity Resource Usage Report

AD-A116 898 COMMAND AND CONTROL TECHNICAL CENTER WASHINGTON DC F/G 17/2
GENERALIZED MONITORING FACILITY. USERS MANUAL.(U)
MAY 82 B WALLACK, G H BERO
UNCLASSIFIED CSM-UM-246-82 NL

3 OF 6
ADA
116898

In both this report and the following report, two special SNUMBs may appear. These SNUMBs are GWAKE and WAITL. These SNUMBs will appear for any activity that was in GWAKE or waiting original core allocation during the entire monitoring session. Due to the manner in which the data collector determines the SNUMB of a job, the real SNUMBs are not known for activities in either of the above categories.

6.3.5 SNUMB-IDENT Report. The SNUMB-IDENT Report is used to correlate the SNUMB, IDENT, and USERID of an activity. This allows operations personnel to identify each job reported in the Memory Map and Activity Usage Reports with a particular user (see figure 6-16).

The report displays the SNUMB, activity number, as well as the $IDENT and $USERID cards supplied at run time. The report also supplies the start and stop times of the activity. At the far end of an entry the type function being performed by an activity (i.e., GELOAD, FILSYS, COBOL, FORTY, etc...) is also presented.

As each activity terminates, its entry is made to this report. Upon termination of the monitor, a summary of each activity still being processed at monitor termination will be given below a line of asterisks. These activities will include the system jobs and will provide an indication of system costs.

6.3.6 Memory Map Report. The Memory Map Report supplies a complete mapping of memory allocation. Memory is broken down into 128K half-quadrant sections and is displayed as such. This report can produce a tremendous quantity of data. Users should consider using time intervals any time the Memory Map is to be produced.

Total memory can be pictured by laying each half quadrant side by side, with a time correlation being made by using the page and line numbers supplied on each output. The output is lined up by matching page numbers and quadrant numbers. The absolute clock time for each quadrant is found on the map of the first half quadrant of the system (0 to 128K). (Refer to figure 6-17).

The first half quadrant shows the time the state was present, the time since the last state change, and the memory used by the Hard Core Modules (HCM). The HCM usage is shown via a ****HCM*** character string.

The remaining space and all other half quadrants display the allocation of memory per job activity. All memory allocated is shown and the format is as follows:

----JOBOL-XX----

with the left and right asterisks representing the upper and lower addresses of the job whose SNUMB is JOBOL, with an activity number of XX. Each character displayed for a job (from and including the asterisks) represents 1K of memory. As a job size decreases, the format changes as follows:

```
              SNUMB-IDENT REPORT COLLECTED ON SYSTEM NMCC2  ON 80-12-15 AT TIME 12:39
SNUMB              START     STOP                  USERID       IDENT
8437T-   2         18:21     18:27                 DJ3JC32406          1820020/30/4641,TEST ESET                          GELOAD
8002T-  35         18:21     18:28                 DJ8XC342LE          1820214/30/2353,TSTCRE                             JOVIAL
28023-   1         18:24     18:28                 DJ4XC31611          2806138/10/5093,NAV-LOOK2,C316,LINCOLN             GMAP
29827-   3         18:21     18:29                 DJ8XC32301          1820011/10/2389,STATREP       SLOAN   323          GELOAD
8496T-   0         18:29     18:29                 DJ3JC32406          1820020/30/4641,TEST ESET                          GELOAD
28923-   7         18:28     18:29                 DJ4XI31622          2806177/30/5168,AEAHAM                             FORTY
8501T-   1         18:30     18:30                 ABC005EEEEEE       1100000000000000000000000000000000000000000000000F OR
8454T-   2         18:24     18:32                 DJ3NI33202          2800165/30/4683,RP                                 COBOL
7776T-   8         18:26     18:32                 DJ8XC341HK          1820223/30/5202,GIPSY-SRC                          GELOAD

FOLLOWING INFO MAY BE INCOMPLETE DUE TO LOST, DATA, NO EOF, OR ACTIVITY WAS ACTIVE WHEN MONITOR ENDED.
$PALC-   1         12:39     19:29
SYSOT-   0         12:39     19:29
$RGIN-   0         12:39     19:29
-TSS--   1         12:39     19:29
LOGON-   0         12:39     19:29
FSYS -   0         12:39     19:29
NCP  -   1         12:39     19:29
TELNE-   1         12:39     19:29
FTS  -   1         14:45     19:29                 NET-EXEC            00000000000000000000000000000000000000000000000000.MF
TLCF -   1         12:39     19:29
DMTEX-   1         12:39     19:29
DMSTA-   1         12:39     19:29                 OPNSUTIL             ZZZ,OPNSTIL                                       DMSTA
VIDEO-   1         12:39     19:29                 OPNSUTIL             ZZZ,OPNSTIL                                       VIDEO
7871T-   2         18:50     19:29                 DJ3JC32402           1820020/30/4641,AIR PATCH TEST 5027     MEACHAM (CT20AIR
NEWRM-   1         12:39     19:29                 OPNSUTIL             ZZZ,OPNSTIL                                       NEWRM
LGEN -   2         12:39     19:29                 OPNSUTIL             ZZZ,OPNSTIL                                       FILSYS
MUM  -   1         12:39     19:29                 OPNSUTIL             ZZZ,OPNSTIL                                       GELOAD
HEALS-   1         12:39     19:29                 HEALS-DATA           ZZZ,OPNSTIL                                       HEAL
7683T-   1         17:18     19:29                 DJ8XI323A2           1820011/10/6642,STP-BUILD                         STPBLD
8603T-   1         19:06     19:29                 DJ8XC32577           1820040/30/6054,BKUP-EPLB,C325,PULMAN             GELOAD
8619T-   1         19:19     19:29                 DJ8XI342RB           1820215/30/7173,CSSTPGM                           COBOL
8617T-   1         19:18     19:29                 DJ3JC32404           1820020/30/4641,TESTBLD                           COBOL
NACE -   1         15:00     19:29                 DJ8XI342Z1           1820215/30/4889,NAC-DEVELOPMENT       NACE   YEAR GELOAD
WAITL- 999         19:18     19:29                 DJ8XC342LE           1820214/30/2353,TSTCRE                            JOVIAL
WAITL- 999         19:19     19:29                 DJ8XC341HK           1820223/30/5202,KETCHUMHK                         FORTY
```

Figure 6-16. SNUMB-IDENT Report

```
                                              MEMORY MAP OF   THE  FIRST HALF OF THE  FIRST QUADRANT                                PAGE   1

                              30        40        50        60        70        80        90        100       110       120
LINE   TOD      DELTA     5678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678
  1- 14.00044 0.00291657  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000---*              *2742
  2- 14.00085 0.00058898  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000---*              *2742
  3- 14.00138 0.00074995  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000---*              *2742
  4- 14.00216 0.00061107  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000---*              *2742
  5- 14.00292 0.00072229  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2800T-000**2742
  6- 14.00328 0.00036108  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2800T-000**2742
  7- 14.00342 0.00013888  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2800T-000**2742
  8- 14.00358 0.00014665  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2800T-000**2742
  9- 14.00372 0.00013888  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2800T-000*
 10- 14.00378 0.00005555  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2800T-000*
 11- 14.00394 0.00016665  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2800T-000* *280
 12- 14.00444 0.00050008  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2800T-000* *280
 13- 14.00539 0.00094458  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000---*                *280
 14- 14.00542 0.00002778  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000---*                *280
 15- 14.00581 0.00038898  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000---*                *280
 16- 14.00650 0.00069439  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000---*                *280
 17- 14.00658 0.00008333  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000---*                *280
 18- 14.00747 0.00088894  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-**280
 19- 14.00758 0.00011110  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-**280
 20- 14.00783 0.00024998  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-**280
 21- 14.00814 0.00030553  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-**280
 22- 14.00822 0.00008333  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-**280
 23- 14.00925 0.00102782  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-**280
 24- 14.00931 0.00005555  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-**280
 25- 14.00931 0.          **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-**280
 26- 14.00983 0.00052776  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-**280
 27- 14.01000 0.00016665  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-**280
 28- 14.01003 0.00002778  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-**280
 29- 14.01006 0.00002778  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-**280
 30- 14.01028 0.00022221  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 31- 14.01189 0.00161111  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 32- 14.01200 0.00011110  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 33- 14.01217 0.00016665  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 34- 14.01247 0.00030565  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 35- 14.01253 0.00005555  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 36- 14.01267 0.00013888  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 37- 14.01289 0.00022221  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 38- 14.01392 0.00102770  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 39- 14.01408 0.00016677  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 40- 14.01419 0.00011110  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 41- 14.01419 0.          **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 42- 14.01453 0.00033331  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 43- 14.01553 0.00099995  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 44- 14.01639 0.00086117  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 45- 14.01647 0.00008333  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 46- 14.01653 0.00005555  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 47- 14.01661 0.00008333  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 48- 14.01711 0.00049996  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 49- 14.01781 0.00069451  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
 50- 14.01792 0.00011110  **********************HCM*******^       -TBD-**---------SYSOT-000---------*   *--SRGIN-000----*2742T-013-*
```

FIGURE 6-17. Memory Map Report
(Part 1 of 3)

```
                    MEMORY MAP OF   THE SECOND HALF OF THE FIRST  QUADRANT                         PAGE   1

           140       150       160       170       180       190       200       210       220       230       240       250
LINE 2345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456
  1- 12-*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
  2- 12-*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
  3- 12-*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
  4- 12-*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
  5- 12-*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
  6- 12-*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
  7- 12-*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
  8- 12-*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
  9-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 10-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 11- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 12- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 13- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 14- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 15- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 16- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 17- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 18- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 19- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 20- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 21- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 22- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 23- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 24- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 25- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 26- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 27- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 28- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 29- 000*-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 30-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 31-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 32-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 33-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 34-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 35-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 36-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 37-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 38-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 39-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 40-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 41-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 42-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 43-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 44-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 45-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 46-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 47-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 48-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 49-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
 50-    *-----------2796T-001---------------**2779T-001-*DMSTA001*---$PALC-001---*--*----$POLT-000--------*------MUM  -001-------*
```

FIGURE 6-17. (Part 2 of 3)

```
                         MEMORY MAP OF   THE SECOND HALF OF THE SECOND QUADRANT                           PAGE    1

      400       410       420       430       440       450       460       470       480       490       500       510
LINE 89012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012345678901234567890123456789012
  1- -----2759T-001----------------*                      *2768T-009*                                *LOGON-000*VIDEO*SSA C
  2- -----2759T-001----------------*                                                                 *LOGON-000*VIDEO*SSA C
  3- -----2759T-001----------------*                                                         HEALS001*LOGON-000*VIDEO*SSA C
  4- -----2759T-001----------------*              *----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
  5- -----2759T-001----------------*              *----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
  6- -----2759T-001----------------*           22**----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
  7- -----2759T-001----------------*           22**----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
  8- -----2759T-001----------------*           22**----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
  9- -----2759T-001----------------*           22**----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
 10- -----2759T-001----------------*           22**----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
 11- -----2759T-001----------------*           22**----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
 12- -----2759T-001----------------*           22**----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
 13- -----2759T-001----------------*           22**----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
 14- -----2759T-001----------------*           22**----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
 15- -----2759T-001----------------*           22**----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
 16- -----2759T-001----------------*           22**----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
 17- -----2759T-001----------------*           22**----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
 18- -----2759T-001----------------*           22**----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
 19- -----2759T-001----------------*           22**----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
 20- -----2759T-001----------------*           22**----------------2768T-010----------------*HEALS001*LOGON-000*VIDEO*SSA C
 21- -----2759T-001----------------*           22**2768T-010*                                HEALS001*LOGON-000*VIDEO*SSA C
 22- -----2759T-001----------------*           22**2768T-010*                                HEALS001*LOGON-000*VIDEO*SSA C
 23- -----2759T-001----------------*           22**2768T-010*         *------FTS  -001------*HEALS001*LOGON-000*VIDEO*SSA C
 24- -----2759T-001----------------*           22*                    *------FTS  -001------*HEALS001*LOGON-000*VIDEO*SSA C
 25- -----2759T-001----------------*           22*                    *------FTS  -001------*HEALS001*LOGON-000*VIDEO*SSA C
 26- -----2759T-001----------------*           22*                    *------FTS  -001------*HEALS001*LOGON-000*VIDEO*SSA C
 27- -----2759T-001----------------*           22*                                           HEALS001*LOGON-000*VIDEO*SSA C
 28- -----2759T-001----------------*           22*                                                   *LOGON-000*VIDEO*SSA C
 29- -----2759T-001----------------*           22*   *------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 30- -----2759T-001----------------*           22*   *------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 31- -----2759T-001----------------*           22*   *------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 32- -----2759T-001----------------*           22*   *------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 33- -----2759T-001----------------*           22*   *------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 34- -----2759T-001----------------*           22*   *------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 35- -001-----------------*                    22*   *------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 36- -001-----------------*                          *------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 37- -001-----------------*    *------FTS -001------**------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 38- -001-----------------*    *------FTS -001------**------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 39- -001-----------------*    *------FTS -001--------------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 40- -001-----------------*                          *------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 41- -001-----------------*             *-TLCF -001-**------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 42- -001-----------------*             *-TLCF -001-**------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 43- -001-----------------*             *-TLCF -001-**------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 44- -001-----------------*             *-TLCF -001-**------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 45- -001-----------------*             *-TLCF -001-**------------------2791T-001-------------------**LOGON-000*VIDEO*SSA C
 46- -001-----------------*-------------------2791T-001------------------*                           *LOGON-000*VIDEO*SSA C
 47- -001-----------------*-------------------2791T-001------------------*  *-------NCP -001--------**LOGON-000*VIDEO*SSA C
 48- -001-----------------*-------------------2791T-001------------------*  *-------NCP -001--------**LOGON-000*VIDEO*SSA C
 49- -001-----------------*-------------------2791T-001------------------*  *-------NCP -001--------**LOGON-000*VIDEO*SSA C
 50- -001-----------------*-------------------2791T-001------------------*  *-------NCP -001--------*           VIDEO*SSA C
```

FIGURE 6-17. (Part 3 of 3)

——JOB01-XXX——	(16K) including SSAs
*JOB02-XXX——	(12K)
JOB03	(7K) - activity discarded
JOB04	(5K) - asterisks discarded
****	(4K) - no identification

As can be seen in figure 6-17, Part 1, every line of the figure has a line number ranging from 1-50. In addition, there is a page number in the upper right corner. When the user wants to match this picture of the first half of the first quadrant with its corresponding half of some other quadrant, the following steps should be followed:

1- Match page numbers (see figure 6-17, Part 2, Part 3)
2- Match the line numbers from identical page numbers.

Two special names can appear in the memory map. If SSA cache memory is configured the following letters will be found in the map, depending on the size of the SSA cache memory:

*SSA CACHE**	12K	
*SSA CACHE	10K	
*SSA CAC	8K	
SSA C	5K	(see figure 6-17 Part 3)

If memory has been released from the system then the letters *-RELEASED* will appear in the dump. This will be repeated depending upon how much memory has been released.

6.3.7 Demand List Report. The Demand List Report shows the memory demand outstanding for each memory state displayed on the memory map. The correlation is made using the same line numbers as the half quadrants of the maps themselves (refer to figure 6-18).

The Demand List Report shows the total memory available, the number of jobs waiting memory, the demand request sizes for each job waiting memory. The memory available is the sum of all holes in memory.

6.3.8 Activity Abort Report. This report is directly related to the Activity Resource Usage Report. This report is produced whenever the Activity Report is produced. For every activity that aborts during the monitoring session, an entry is made to this report. The entry gives the SNUMB, Activity Number, Abort Code, CPU Time, Run Hours, USERID, and IDENT for the activity.

The Abort Code is either an octal number or an alphanumeric value. The meaning of these codes can be found in Appendix A of Honeywell Manual DD19 (GCOS).

DEMAND LIST IN K BLOCKS PAGE 1

LINE								
1-	14K AVAILABLE	5 WAITING-	38	38	38	34	34	
2-	41K AVAILABLE	5 WAITING-	38	38	38	34	34	
3-	41K AVAILABLE	5 WAITING-	38	38	38	34	34	
4-	41K AVAILABLE	5 WAITING-	38	38	38	34	34	
5-	52K AVAILABLE	6 WAITING-	17	38	38	38	34	34
6-	35K AVAILABLE	6 WAITING-	3	38	38	38	34	34
7-	35K AVAILABLE	6 WAITING-	3	38	38	38	34	34
8-	35K AVAILABLE	6 WAITING-	3	38	38	38	34	34
9-	46K AVAILABLE	6 WAITING-	3	38	38	38	34	34
10-	43K AVAILABLE	5 WAITING-	38	38	38	34	34	
11-	43K AVAILABLE	5 WAITING-	38	38	38	34	34	
12-	43K AVAILABLE	5 WAITING-	38	38	38	34	34	
13-	5K AVAILABLE	5 WAITING-	11	38	38	34	34	

Figure 6-18. Demand List Report

The CPU time is the amount of CPU time in milliseconds used by this activity prior to its abort. This is the total CPU time, generated during monitoring session.

The Run Hours is the amount of time this activity has been known to the monitor (see figure 6-19).

At the bottom of the report, the percent of total CPU time, total I/O time, and total Run time used by the aborted activities is given. This percentage does not include any system jobs (i.e., program number <= 14) or any selected SNUMBs processed by Action Code ABORT. The selected SNUMBs are listed at the end of the report.

6.3.9 Jobs Out of Core Report. This report gives a detailed picture of memory demand outstanding for each memory state displayed on the memory map. The correlation is again made by matching the page numbers, line numbers, and times of day (see figure 6-20). If a line number does not appear, no jobs were out of memory. If a line number appears more than once, more than two jobs were out of memory at that time. For each line, the report presents the following:

- Line number (always 50 if out of core report is run without memory map)
- SNUMB and activity number of job waiting memory
- Memory demand and urgency
- Whether the job could fit in memory if available memory were compacted (FWC)
- Whether it could fit into an existing hole of memory (FWOC)
- Whether the job is a new request (NEW), a swapped job (SWAP), or a job GEWAKE (GWKE)
- How many attempts have been made by the Core Allocator to place this job into memory

It is also possible for a page number to be repeated. This occurs because the memory map prints 50 lines per page. Since the Out of Core Report can print several lines for each memory map line, it might be necessary to use several pages for each memory map page.

This report can produce a tremendous amount of output. Users should consider using the time interval option if this report is needed.

6.3.10 Excessive Resource Use Report. This report is directly related to the Activity Resource Usage Report. For every activity that is apparently using more than a preset amount of specified resources (Wasted Memory, Memory Used, I/O Secs, CPU Secs, Ratio), an entry is made to this report. The user must realize the Wasted Memory column is not an absolute statement that a user is wasting memory. Rather, it is a

ACTIVITY ABORT REPORT ON SYSTEM NMCC2 ON 80-12-15 AT TIME 12:39

SNUMB-ACT	ABRT CODE	CPU(MS)	RUN(HR)	USERID	IDENT	
7375T- 2	Q6	2414	0.002	DJ8XI70203	1829115/10/6544,PELLERIN	GELOAD
7413T- 3	GR	2703	0.009	DJ8XI70203	1829115/10/6544,PELLERIN	GELOAD
7431T- 6	031	10317	0.011	DJ8XI70203	1829115/10/6544,PELLERIN	GELOAD
7483T- 3	077	22691	0.048	DJ8XI70203	1829115/10/6544,PELLERIN	GELOAD
7513T- 3	SC	2090	0.004	DJ8XI70357	2802112/30/6242,TITUS	GELOAD
7545T- 3	115	2932	0.008	DJ8XI70357	2802112/30/6242,TITUS	GELOAD
7676T- 1	051	495	0.005	DJ8XI342DH	1820215/30/4938,FTS	FTSBIP
WAS01- 1	FS	584	0.040	OPNSUTIL	1727330/10/5471,WAS01	FILSYS
7713T- 1	005	108542	0.406	DJ3JC32411	1820020/30/3170,SANDY	FILEDI

THE % OF CPU TIME USED BY ABORTED JOBS WAS 5.29
THE % OF IO TIME USED BY ABORTED JOBS WAS 2.01
THE % OF RUN TIME USED BY ABORTED JOBS WAS 4.67

**** THE ABOVE PERCENTAGES DO NOT INCLUDE ANY SYSTEM JOBS OR ANY OF THE FOLLOWING JOBS ****
HEALS MUM MSM GDR NEWRM

Figure 6-19. Abort Report

JOBS OUT OF CORE REPORT FOR SYSTEM NMCC2 COLLECTED ON 81-04-09 PAGE # 1

INE	TIME	SNUMD	DMND	URG	FWC	FWOC	TYPE	TRIES	SNUMD	DMND	URG	FWC	FWOC	TYPE	TRIES
1	14.00044	FSYS	0 5	0	NO	NO	GWKE	0	NCP	1 26	0	NO	NO	GWKE	7
1	14.00044	TELNE	1 16	0	NO	NO	GWKE	3	FTS	1 24	0	NO	NO	GWKE	2
1	14.00044	TLCF	1 14	0	NO	NO	GWKE	3	DMTEX	1 4	0	NO	NO	GWKE	1
1	14.00044	HEALS	1 8	0	NO	NO	GWKE	3	NEWRM	1 3	0	NO	NO	GWKE	1
2	14.00083	HEALS	1 8	32	YES	YES	SWAP	1	FSYS	0 5	0	NO	NO	GWKE	0
2	14.00083	NCP	1 26	0	NO	NO	GWKE	7	TELNE	1 16	0	NO	NO	GWKE	3
2	14.00083	FTS	1 24	0	NO	NO	GWKE	2	TLCF	1 14	0	NO	NO	GWKE	3
2	14.00083	DMTEX	1 4	0	NO	NO	GWKE	1	NEWRM	1 3	0	NO	NO	GWKE	1
3	14.00158	2768T	0 46	5	NO	NO	NEW	1	FSYS	0 5	0	NO	NO	GWKE	0
3	14.00158	NCP	1 26	0	NO	NO	GWKE	7	TELNE	1 16	0	NO	NO	GWKE	3
3	14.00158	FTS	1 24	0	NO	NO	GWKE	2	TLCF	1 14	0	NO	NO	GWKE	3
3	14.00158	DMTEX	1 4	0	NO	NO	GWKE	1	NEWRM	1 3	0	NO	NO	GWKE	1
4	14.00219	2800T	0 11	24	YES	NO	NEW	1	FSYS	0 5	0	NO	NO	GWKE	0
4	14.00219	NCP	1 26	0	NO	NO	GWKE	7	TELNE	1 16	0	NO	NO	GWKE	3
4	14.00219	FTS	1 24	0	NO	NO	GWKE	2	TLCF	1 14	0	NO	NO	GWKE	3
4	14.00219	DMTEX	1 4	0	NO	NO	GWKE	1	NEWRM	1 3	0	NO	NO	GWKE	1
5	14.00292	NEWRM	1 3	60	YES	YES	SWAP	1	2791T	0 51	5	NO	NO	NEW	1
5	14.00292	FSYS	0 5	0	NO	NO	GWKE	0	NCP	1 26	0	NO	NO	GWKE	7
5	14.00292	TELNE	1 16	0	NO	NO	GWKE	3	FTS	1 24	0	NO	NO	GWKE	2
5	14.00292	TLCF	1 14	0	NO	NO	GWKE	3	DMTEX	1 4	0	NO	NO	GWKE	1
6	14.00328	2791T	0 51	5	NO	NO	NEW	2	FSYS	0 5	0	NO	NO	GWKE	0
6	14.00328	NCP	1 26	0	NO	NO	GWKE	7	TELNE	1 16	0	NO	NO	GWKE	3
6	14.00328	FTS	1 24	0	NO	NO	GWKE	2	TLCF	1 14	0	NO	NO	GWKE	3
6	14.00328	DMTEX	1 4	0	NO	NO	GWKE	1							
7	14.00342	2791T	0 51	5	NO	NO	NEW	3	FSYS	0 5	0	NO	NO	GWKE	0
7	14.00342	NCP	1 26	0	NO	NO	GWKE	7	TELNE	1 16	0	NO	NO	GWKE	3
7	14.00342	FTS	1 24	0	NO	NO	GWKE	2	TLCF	1 14	0	NO	NO	GWKE	3
7	14.00342	DMTEX	1 4	0	NO	NO	GWKE	1							
8	14.00358	2791T	0 51	5	NO	NO	NEW	4	FSYS	0 5	0	NO	NO	GWKE	0
8	14.00358	NCP	1 26	0	NO	NO	GWKE	7	TELNE	1 16	0	NO	NO	GWKE	3
8	14.00358	FTS	1 24	0	NO	NO	GWKE	2	TLCF	1 14	0	NO	NO	GWKE	3
8	14.00358	DMTEX	1 4	0	NO	NO	GWKE	1							
9	14.00372	2791T	0 51	5	NO	NO	NEW	5	FSYS	0 5	0	NO	NO	GWKE	0
9	14.00372	NCP	1 26	0	NO	NO	GWKE	7	TELNE	1 16	0	NO	NO	GWKE	3
9	14.00372	FTS	1 24	0	NO	NO	GWKE	2	TLCF	1 14	0	NO	NO	GWKE	3
9	14.00372	DMTEX	1 4	0	NO	NO	GWKE	1							
10	14.00378	2801T	0 11	24	YES	NO	NEW	1	2791T	0 51	5	NO	NO	NEW	6
10	14.00378	FSYS	0 5	0	NO	NO	GWKE	0	NCP	1 26	0	NO	NO	GWKE	7
10	14.00378	TELNE	1 16	0	NO	NO	GWKE	3	FTS	1 24	0	NO	NO	GWKE	2
10	14.00378	TLCF	1 14	0	NO	NO	GWKE	3	DMTEX	1 4	0	NO	NO	GWKE	1
11	14.00394	2791T	0 51	5	NO	NO	NEW	7	FSYS	0 5	0	NO	NO	GWKE	0
11	14.00394	NCP	1 26	0	NO	NO	GWKE	7	TELNE	1 16	0	NO	NO	GWKE	3
11	14.00394	FTS	1 24	0	NO	NO	GWKE	2	TLCF	1 14	0	NO	NO	GWKE	3
11	14.00394	DMTEX	1 4	0	NO	NO	GWKE	1							
12	14.00444	2791T	0 51	5	NO	NO	NEW	8	FSYS	0 5	0	NO	NO	GWKE	0
12	14.00444	NCP	1 26	0	NO	NO	GWKE	7	TELNE	1 16	0	NO	NO	GWKE	3
12	14.00444	FTS	1 24	0	NO	NO	GWKE	2	TLCF	1 14	0	NO	NO	GWKE	3
12	14.00444	DMTEX	1 4	0	NO	NO	GWKE	1							
13	14.00539	2791T	0 51	5	NO	NO	NEW	9	FSYS	0 5	0	NO	NO	GWKE	0

FIGURE 6-20. Jobs out of Core Report

statement that the $LIMITS card appears to be requesting more memory than is actually required by this job. The user should be questioned in order to determine if this is in fact true. In the Honeywell System, a user will receive whatever amount of memory requested on the $LIMITS card, whether or not the amount of memory is actually needed. The Ratio column shows the ratio of the total elapsed time for an activity divided by the total memory time for the activity. This value gives an indication of the activity lengthening factor; i.e., how run time is affected by resource contention.For those activities using excessive memory the report also indicates the amount of time the activity was in memory. The default values for an entry being made to this report are listed in table 6-4. These values can be changed via a previously described input option. This report will be produced whenever the Activity Resource Report is produced and will be turned off whenever the Activity Resource Report is off (see figure 6-21).

6.3.11 <u>Peripheral Allocation Status Report</u>. This report will track an activity as it proceeds through different phases of Peripheral Allocation. The report will list the SNUMB-Activity #, amount of memory the activity will require, its current status, the time it entered that phase of allocation, the time it completed that phase of allocation, the total time spent in a given phase of allocation, the device type it is waiting for and the number of devices the activity is waiting for. Due to the manner in which data is collected for this report, it is possible that certain phases of allocation will be missed, especially if that phase of allocation occurs within a short time span. This report will give a good indication of how long it is taking activites to pass through the Peripheral Allocation process. Following is a list of the more common phases of peripheral allocation and their meanings:

New Act - Activity has just entered the Peripheral Allocator
Wait Media - Activity is waiting for a device
Wait Mnt - Activity is waiting for a patch or tape to be mounted
Core Queue Full - Activity has been completely processed and is waiting for the Peripheral Allocator to send the job to the core allocator
Alloc Done - Activity has been sent to core allocator. For this case the stop time and total time columns have no real meaning. These columns simply are reporting the amount of time it took the monitor to realize that the activity had reached the core allocator
LIMBO - Activity is in Limbo and has not even been granted permission to run
HOLD - Activity is in Hold and has not even been given permission to run

Only activities found to be in a PALC state for more than 600 seconds will be reported. This limit can be changed by using the PALC input option. See figure 6-22 for a sample of this report.

6.3.12 <u>Plot Reports</u>. Three different plot reports are produced by the data reduction program. All plots are produced under 10-minute intervals, where the interval can be modified by the user. At every allocator call the various parameters to the plots are accumulated and every 10 minutes the accumulated parameters are averaged and an average value is output

EXCESSIVE RESOURCE USAGE REPORT ON SYSTEM UNAH66 ON 81-12-17 AT TIME 10:01

SNUMB-ACT	WASTED MEMORY	MEM USED	IO SECS	CPU SECS	RATIO	MEM MIN	USERID	IDENT	
2027Q- 1		56				1.2	FCCCSE	1020,WA024,CSE,250,MCCANN,SECRET	ASCA
2044T- 1		81				2.8	FCCCSE	1010,WA803,CSE,264,BARRETT,UNCL	CBL74
2057T- 1		64				3.4	FCCCSD	1010,NS0033,CSD,263,PADILLA,UNCL	CBL74
2083Q- 1		56				1.0	FCCCSE	1020,WA024,CSE,250,MCCANN,SECRET	ASCA
2085T- 1		92				5.0	DBA	1020,TRAX.A,CSA,254,MATHEWS,SECRET	TP-ONL
2106T- 1		81				2.7	FCCCSE	1010,WA803,CSE,264,BARRETT,UNCL	CBL74
SR01 - 5		65				0.6	FCCCS	1030,SR01,CSC,250,MCCANN,TOPSEC	SR014
2158Q- 1		74				0.9	DBA	1020,DB04TST,CSA,245,ROSSB,UNCL	ASCA
SR01 - 9		78				1.2	FCCCS	1030,SR01,CSC,250,MCCANN,TOPSEC	SR015
SR01 - 13		61				1.0	FCCCS	1030,SR01,CSC,250,MCCANN,TOPSEC	SR016
2181T- 1		64				2.2	FCCCSE	1020,WA00C11,CSE,258,NOLL,UNCL	CBL74
2189T- 1		64				1.6	FCCCSE	1020,WA003,CSE,256,SCHLACHTER,UNCL	CBL74
2201T- 1		78				5.4	FCCCSE	1010,WA301,CSE,261,SMOCKE,UNCL	CBL74
2212T- 1		79				4.5	DBA	1010,DB04TEST,CSA,235,BOUDREAUX,UNCL	AMDADF
2206T- 1		78				5.2	FCCCSE	1010,WA014SR,CSE,246,CSMITH,UNCL	CBL74
S5203- 1					20.6		FCCCS	1030,SM852,TPC,251,MITCHELL,TOPSEC	SM852
2199T- 1	45	69				12.8	FCCCSE	1020,WA003RUN,CSE,258,SCHLACHT,SECRET	GELUAD
2233T- 1		79				15.2	DBA	1010,DB04TEST,CSA,235,BOUDREAUX,UNCL	AMDADF
2267T- 1		79				0.7	DBA	1010,DB04TRY1,CSA,235,BOUDREAUX,UNCL	AMDADF
DM4TP- 1		82				13.9	OPNSUTIL	1030,TRAX.P,CSA,254,MATHEWS,UNCL	TP-ONL

Figure 6-21. Excessive Resource Usage Report

PERIPHERAL ALLOCATION STATUS REPORT

SNUMB	MEMORY	STATUS	TIME IN	TIME OUT	TOTAL TIME(SEC)	DEVICE TYPE	NUMBER
7338T- 1	10	WAIT MNT	12:42	12:52	600.		
7338T- 4	51	CORE QUE FULL	12:46	12:57	660.		
29675- 2	36	WAIT MEDIA	12:49	13:00	660.	DSS191	2

Figure 6-22. Peripheral Allocation Status Report

to the plot. Every 10th output will also display the present time of day. Each horizontal position has a delta value, which is printed on the plot. The delta value is computed from the following formula:

$$\frac{\text{(Upper Plot Limit - Lower Plot Limit)}}{126}$$

The plot limits can be set by the user, with the default values shown in table 6-3. If a plotted variable is beyond or on an axis limit, it will be positioned at the axis limit. If any 2 points coincide, the position of coincidence will be marked with a 2. If 3 points coincide, the position of coincidence will be marked with a 3. (See figure 6-23). The end of the plot will contain a summary of the minimum and maximum values of each curve.

In figure 6-23 we see that there was no memory shortfall at all (points A & B are coinciding with the left axis; i.e., a 2 is output). At 14:31 both curves continue to coincide, but there is now a shortfall of 36K (12th point times delta of 3). At 14:41 the memory shortfall of the CALC increased to 75K but the memory shortfall of the CALC plus the PALC queue increased to 99K.

In order to obtain a continuous curve from the plots the user needs only to connect the corresponding letter points (see figure 6-23).

6.3.12.1 Plot 1 - Available Memory vs. Outstanding Demand in Core Allocator Queue vs. Outstanding Demand in Core Allocator Queue + Peripheral Allocator Queue. This three parameter plot provides an overview of the time dependence of both the system load and memory availability. It can aid in better balancing the workload across the day and in determining when memory shortfalls or surpluses exist. The addition of memory demand, waiting in the Peripheral Allocator, is an attempt to give a truer picture of how much additional memory could be properly utilized, if available. As long as the B and C points fall to the left of the A points, a memory surplus exists. If the B and C points fall to the right of the A points, a memory shortfall is present.

6.3.12.2 Plot 2 - Memory Shortfall in Core Allocator vs. Memory Shortfall in Core Allocator + Peripheral Allocator. This plot is obtained from the previous plot by simply calculating the actual shortfall and plotting the shortfall points.

6.3.12.3 Plot 3 - Number of Activities in Core Queue vs. Number of Activities in Peripheral Allocator Queue. In this plot the number of activities being delayed, instead of their memory demand, is plotted.

6.3.12.4 Plot 4 - Average Size of TSS, FTS, NCP. This plot displays the average size of TSS, FTS and NCP as they change their demand for memory over time. These three programs whose memory demand would significantly change over time. The FTS and NPC programs are part of the WIN subsystem.

DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 12:39:46 ON 80-12-15

MEMORY SHORTFALL IN CALC VS SHORTFALL IN CALC+PALC PLOT- 2

```
DELTA-     3.0000E 00     A= CALC    B=+ PALC

TIME OF DAY                                       MEMORY (K WORDS)
     0.                          9.4500E01                     1.8900E 02                    2.8350E 02                  3.7800E 02

Y---------Y---------Y---------Y---------Y---------Y---------Y---------Y---------Y---------Y---------Y---------Y---------Y---------Y

I 12:49:21.80
2
2
2
2
2
2
2
2
I 14:21:23.10
            2
                         A       B
                                                                 A B
                         A  B
                          A    B
                                 A                                            B
                              A                                                       B
                                        A                                   B
  16:01:34.50                        A                                                              B

     CURVE      MINIMUM         MAXIMUM
     CALC       0.              0.1950E 03
   + PALC       0.              0.3000E 03
```

Figure 6-23. Standard Plot

6.3.13 Memory Statistics Report. This report is produced after the histograms. It details all the information needed to start a system analysis as detailed in section 14. The report is shown in figure 6-24. The values for this report are obtained as described in section 14.6.3.

6.3.14 Special Job Memory Reports. This report details the memory demands made by a series of jobs specially requested by the analyst (see SPECL option). Figures 6-25 and 6-26 display the format for these reports.

Figure 6-25 displays the Memory Demand Report. Every time a specially requested job issues a MME GEMORE for memory or is swapped out/into memory, an entry is made to this report. In figure 6-25, we see that FTS issued a GEMORE for 5K of memory at 1417 hours. At the time of the MME GEMORE, FTS was at 50K. The -99999 in the Time to Satisfy column indicates that this was the time when the GEMORE was issued. As can be seen, the GEMORE was satisfied at 1418 after a wait of 72.5 seconds and FTS has grown to 55K. At 1420, FTS issued another GEMORE. Its current size is only 38K which implies that between 1418 and 1420, FTS must have released 17K of memory. At 1421, after 68.5 seconds, the GEMORE was satisfied. However, it should be noticed that the size of FTS has not changed. In addition, the next entry seen for FTS is a SWAP with a memory demand of 40K. This series of events implies that at 1420, FTS issued a GEMORE for 2K of memory and the system was required to SWAP FTS from memory before this demand could be satisfied. Therefore, it actually took a total of (68.5+3.8) seconds before the 2K memory request was satisfied.

In figure 6-26, the second of the Special Memory Reports is displayed. An entry in this report is made under the same time interval constraints as the various memory plot. The report shows the average size of the specially requested jobs over the respective time intervals.

6.4 Error Messages

All error messages are self-explanatory or else followed by the words "For Information Only." In this case, the message can be ignored and processing will continue, without error.

MEMORY STATISTICS TABLE FOR D.JAHGG

DATE	START	STOP	HOURS	CPU/IO RATIO	AVG ACT SIZE(K)	USER MEM AVAILABLE	SYSTEM MEMORY	EXCESS MEMORY (+/-) CALL	EXCESS MEMORY (+/-) PALL
811217	1001	1130	1.48	0.336	25.76	210	294	67	60

AVG # USER ACT WAITING MEM	AVG # SYSTEM ACT WAITING MEM	AVG # USER ACT IN MEM	AVG # SYSTEM ACT IN MEM	RATIO OF DURATION VS MEMORY TIME	% SLAVE MEM USED	TIME USER ACT SWAPPED
1.000	0.-	3.765	8.771	1.150	75.757	0.010 SEC

WAIT TIME FOR ORIGINAL ALLOCATION	DURATION OF USER ACTIVITY	# USER SWAPS	ACT/HOUR (THROUGHPUT)	USER ACT/HOUR (THROUGHPUT)	SWAPS PER HOUR
25.500	70.050 SEC	125	177.920	121.770	185.361

Figure 6-24. Memory Statistics Report

SPECIAL JOB MEMORY DEMAND REPORT ON SYSTEM UHCC ON 82-03-01

TIME	DEMAND TYPE	TIME TO SATISFY IN .1 SEC	SNUMB	SIZE OF DEMAND IN K	CURRENT SIZE IN K
1417	GEMORE	-99999	FTS	5	50
1418	GEMORE	725	FTS	5	55
1420	GEMORE	-99999	FTS	2	38
1421	GEMORE	685	FTS	2	38
1423	GEMORE	38	FTS	40	40
.	.	.	.	.	.
.	.	.	.	.	.
.	.	.	.	.	.

**** TOTAL WAIT TIME FOR FTS WAS 5793 .1 SEC

Figure 6-25. Special Job Memory Demand Report

SPECIAL JOB MEMORY SIZE REPORT ON SYSTEM NMCC ON 82-03-01

TIME	SNUMB	AVG SIZE	SNUMB	AVG SIZE	SNUMB	AVG SIZE
1415	FTS	63	NCP	29	TS1	124
1426	FTS	56	NCP	29	TS1	120
1436	FTS	47	NCP	29	TS1	81
1446	FTS	38	NPC	29	TS1	114

Figure 6-26. Special Job Memory Size Report

6.5 Multireel Processing

If more than a single reel of data has been collected, a series of messages will be printed at the computer console informing the operator that a new data reel is required. The following are the messages produced.

a. DISMOUNT REEL #XXXXX THEN MOUNT REEL NUMBER YYYYY ON ZZZZZ

   In this case, XXXXX is the old reel number, YYYYY is the new reel number, and ZZZZZ is the tape drive ID.

   If the operator fails to mount the new tape, the above message will be repeated three times, after which the program will terminate, and all reports will be produced.

b. IS TAPE XXXXX MOUNTED ON DRIVE ID YYYYY (Y/N)

   In this case, XXXXX is the tape number being requested and YYYYY is the appropriate tape drive ID.

   This message occurs when the data reduction program finds the wrong tape has been mounted (by comparing internally generated tape labels). If the operator answers N, the message in (c) below is produced. If the operator answers Y, the data reduction program will terminate and all reports will be produced. In this case, the data reduction program is unable to process the tape. Even though the operator is mounting the correct tape, the internal label on the new tape does not match that being requested by the old tape. The user should check the data collection session to insure that the operator did not respond with an incorrect tape number during multireel change.

   After entering the Y or N, the operator will need to hit the EOM key twice in order for the response to be transmitted.

c. WRONG REEL JUST MOUNTED, DISMOUNT AND MOUNT REEL XXXXX ON ZZZZZ

   In this case, XXXXX is the new reel number, and ZZZZZ is the tape drive ID.

d. CAN TAPE XXXXX BE MOUNTED ON DRIVE YYYYY (Y/N)

   In this case, XXXXX is the new desired reel and YYYYY is the tape drive ID.

   If the operator fails to answer this message, it will be repeated until he responds with a "Y" for YES or "N" for NO. If he types in "Y", then message (a) will be repeated. If he types in "N", then the program will be terminated and all reports will be produced.

6.6 Tape Error Aborts

During the course of processing, it is possible that the operator will be required to abort the data reduction program due to an irrecoverable tape error. If such a condition occurs, the operator should abort this job with a "U" abort. This will allow the data reduction program to enter its wrap-up code processing and produce all reports generated prior to the tape error.

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 7. MASS STORE MONITOR DATA REDUCTION PROGRAM (MSMDRP)

7.1 Introduction

The Mass Store Monitor Data Reduction Program is a FORTRAN program that sequentially processes data the Mass Store Monitor collected and wrote on tape. MSMDRP produces a number of reports depicting the physical and logical usage of the mass storage subsystem during the monitoring period. A list of these reports is found in table 7-1 and report descriptions are presented in subsection 7.5.

The Mass Store Monitor and its Data Reduction Program were conceived as a response to the need for information on the rate and characteristics of usage of mass store subsystems. The information collected is applicable in the following areas:

- Discovery of improper configurations (software or hardware), e.g., not alternating usage of dual physical channels configured on a subsystem.

- Discovery of improper device utilization, e.g., use of only a small number of the devices configured instead of having the activity spread over all configured devices.

- Discovery of open file allocation on a device which can cause long and frequent arm movement.

- Identification of files (either system or user data base) which are frequently accessed and quantification of the rates of access to them.

There are two inputs to the MSMDRP. The first is the data tape produced by the MSM in the General Monitor Collector. The second input is a set of report option control cards used to alter the reports in some way other than the standard default. The various user input options and their formats are described in subsection 7.6. The actual reports produced by the MSMDRP are described in subsection 7.5.

The Mass Store Monitor Data Reduction Reports can be used to assist the analyst in applying models in the area of system performance evaluation by providing computer system resource usage information in a format conducive to defining the system workload. Models of computing systems are frequently used to evaluate configurations which are not currently available or are perhaps unrealized. The usefulness of this type of model depends upon two basic characteristics: (1) how faithfully the model represents the operation of the system being modeled, and (2) how faithfully the input parameters to the model represent the workload to be placed on the system. MSM and MSMDRP are key contributors to such model development.

Table 7-1. MSM/MSMDRP Reports

1 System Configuration and Channel Usage Report (File 42)

2 System Summary Report (File 42)

3 System Traces Captured by Monitor Report (File 42)

4 Channel Status Changes Report (File 29)

5 Physical Device, Device ID Correlation Table Report (File 42)

6 Device Space Utilization Report (File 42)

7 Device Seek Movement Report (File 42)

8 Head Movement Efficiency Report (File 42)

9 System File Use Summary Report (File 21) (NAME=SYSFILES)

10 Individual Module Activity Report (File 21) (NAME=SYSFILES)

11 SSA Module Usage Report by Job (File 21)

12 File Code Summary Report (File 23) (NAME=FILECODE)

13 CAT/File String Report (File 23)

14 Connect Summary Report by Userid/SNUMB (File 23)

15 Activity Summary Report (File 24) (NAME=ACTIVITY)

16 Device Area File Code Reference Report (File 22) (NAME=AREA)

17 Device File Use Summary Report (File 21) (NAME=FILEUSE)

18 Chronological Device Utilization Report (File 26) (NAME=CHRONO)

19 FMS Cache Report (File 21)

20 Connects Per 10 Minute Report (File 20) (NAME=RATE)

21 Proportionate Device Utilization Report (File 42)

22 Elapsed Time Between Seeks Report (File 42)

23 Data Transfer Size Report (File 42)

24 Number of DCWs Per Connect Report (File 42)

7.2 Data Collection Methodology

The MSM in the General Monitor Collector processes GCOS trace types 7 and 15 and collects information to monitor the usage of the entire disk subsystem. The information collected on the occurrence of the above traces enables the MSMDRP to identify the activity issuing the I/O request, the file being accessed, the disk pack upon which the file is located, arm movement required in order to accomplish the requested file accessing, and the type of accessing being requested; e.g., read, write, write verify, etc.

If the system being monitored by the MSM is configured with SSA Cache Core, the MSM will create two direct transfer traces (types 73 and 76) in order to collect data to analyze the effectiveness of SSA Cache Core. The method for generating these new direct transfer traces is described in subsection 5.2.2, and the formats for the MSM generated records used by the MSMDRP are described in subsection 5.4.3.

Finally, if the system being monitored by the MSM is configured with FMS Catalog Cache, a data record is generated so that the MSMDRP can report on the effectiveness of FMS Catalog Cache.

7.3 Analytical Methodology

An evaluation of the Mass Storage Subsystem reports produced by the MSMDRP requires concurrent use of the reports produced by the Channel Monitor Data Reduction Program (CMDRP). Chapter 14 provides a detailed description of the procedure to be followed in such an evaluation. Subsection 8.3 provides a detailed description of the entire I/O process, and the traces generated during the processing of an I/O request. In general, the CMDRP is used to identify channels and/or devices which are acting as bottlenecks to the efficient operation of the system, while the MSMDRP reports are used to determine the exact activities, files, and file codes that are causing the contention uncovered by the CMDRP reports. The MSMDRP reports will also identify those devices experiencing seek elongation problems and the files upon these devices which are responsible for the seek elongation. Finally, the MSMDRP reports will identify those files that are candidates for device relocation or placement into Hard Core or SSA Cache Buffer space.

Before a user conducts a Mass Storage Subsystem Evaluation, it is important to have an understanding of the entire I/O process. Subsection 8.3 provides a detailed description of the entire I/O process and all traces generated during the processing of an I/O request. In this subsection, a description of only the connect (trace type 7) event will be presented.

Each time a system program or application program issues an I/O request (read disk/tape, write disk/tape, seek, etc. . .) the GCOS system will generate a trace type 7 (connect event). Upon the occurrence of this event, several internal tables are updated and it is these tables that the

MSM references in order to generate its data record. A program's SSA area contains tables for the Peripheral Assignment Table (PAT) and the PAT Pointer. These are used to describe the device and space allocation for a particular file and the file code to correlate a user file code to the PAT and the device on which that file is allocated. The .CRIO and .CRCT tables contain descriptive information concerning device and channel configuration. Finally, the program's SSA area also contains an area which is used for I/O entries. These entries are each 11 words long and contain detailed information concerning the I/O just requested. They are referred to as the 11 word I/O queue entry.

I/O requests can be of two types (single or multicommand). Multicommands are of the type seek-read, seek-write, or seek-write verify. Single commands can be status requests of certain types, or reads/writes, where seeks are not required. These different types of I/O commands are processed and reported in different fashions by the various MSMDRP reports (see individual output reports). Finally, whenever the system generates a multi I/O command, it is necessary for the system to record the actual seek address being requested. Normally, this seek address is stored in I/O queue word number 4. Whenever the MSM processes a multicommand, it expects to find a valid seek address at this location. However, there are certain occurrences when a multicommand is issued and I/O queue word 4 does not contain a valid seek address. In these cases, Bit 32 of I/O queue word 2 is set to a 0. The Computer Performance Evaluation Office is currently conducting studies to determine exactly when this nonstandard procedure occurs and if there is any manner in which the MSM can determine the correct seek address. Under the current processing procedures, the MSMDRP recognizes the seek address as being invalid and performs certain special processing in order to recover from this event, thereby affecting several of the output reports (see individual output reports).

7.4 Data Reduction Methodology

The MSMDRP currently uses random I/O (File 58) to process histogram data for the Device Space Utilization and Device Seek Movement reports. This feature allows the MSMDRP to process an unlimited number of devices with a minor increase in memory requirements. As delivered, the MSMDRP will process data describing 75 mass storage devices and 40 mass storage channels. It will produce 64 unique histograms with no random I/O. If the number of channels or devices is insufficient, the user will need to edit file B29IDPXO/SOURCE/MSM. The user should enter the edit subsystem and process the following command:

```
B RS:/NRDEVXX=XX75/;*:/NRDEVXX=XX new number of devices/

B RS:/NRCHANXX=XX40/;*:/NRCHANXX=XX number of new channels/
```

For each additional device, the size of the program will increase by 10 words and for each additional channel, the program will increase by 45 words. For the above edit, the character "X" signifies a space.

The next variable that will need to be changed is RPTCNT. This number represents the total number of histograms and reports that will be processed with no random I/O. To calculate the value required, the following formula should be used.

(number of devices actually configured)*2+8

If this value is less than 72 (32 disk devices), no change is required. If the value required is greater than 72, the user may alter this value. This will help to limit the amount of random I/O being performed but will increase storage by 80 words for each increment above 72. This trade-off between CPU/IO time and memory must be made at the discretion of the user. In order to change this value, the following edit function should be performed:

B RS:/RPTCNTX=X72/;*:/RPTCNTX=Xnew value/ (11 occurrences)

As in the earlier edit example, the character "X" should not be typed, but is being used to represent a blank column.

After performing the above edits, the user should recompile the source program by entering the card subsystem and issuing a run command.

7.5 MSMDRP Output

The MSMDRP produces a series of 24 reports listed in table 7-1 over which the user has limited control. Those eight reports with a NAME=codename designation offer greater parameter control to the user. This parameter control will be described in subsection 7.6. In table 7-1, the file nn designation indicates the file code used to record the given report and is of no real concern to the user. In addition, a series of messages are produced which supply the user with information concerning special processing events that occurred during the execution of the data reduction program. Most of these processing messages are for information only, and can be ignored. The following subsections will describe all the reports listed in table 7-1, and subsection 7.5.25 will describe the processing messages that may be produced during the course of data reduction.

7.5.1 System Configuration and Channel Usage Report (File 42). This report documents the system identification, configuration, and the date and time of the monitoring period, as well as reporting the usage of all configured I/O channels. Figure 7-1 is an example of this report. The heading line indicates the software version number that corresponds to this document. The version number should be 01-82. The first line after the heading provides the tape number(s) the report was generated from, the system identification, the date (in the form year, month, and day - YYMMDD), and the start and stop times (HH:MM:SS) of the MONITORING SESSION. The next several lines of output describe the overhead of all GMF

```
************************************************************
* * *         M A S S  S T O R A G E  M O N I T O R     * * *
* * *                   VERSION  01-82                   * * *
************************************************************

      TAPE # 24502
  SYSID                DATE       START TIME    STOP TIME

OSCC2 ,6.4.ID     82-01-08       13:49:04      14:31:40        FOR A TOTAL OF 0.71 HOURS

               MONITOR            TIME(SEC)          % OVERHEAD
                EXEC                 100                 1.96
                MUM                  120                 2.35
                MSM                  160                 3.13
                NAME                  40                  .78
                FMS                   50                  .98
                TOTAL                                    8.42

CONFIGURATION:  DUAL   PROCESSOR 6680,  DUAL  IOM,  512K  MEMORY - 52 OF WHICH WERE HCM
                       THE HCM DOES NOT INCLUDE 3K FOR .CALC AND 6-8K FOR FILSYS
                     CPUS ACTUALLY CONFIGURED = 2.00  CPUS ACTUALLY AVAILABLE = 1.75
                                         IOM NUMBER 0

 CHANNEL              TYPE          CROSSBAR        CONNECTS
  0-08               .DS450           0-09            47750
                                      1-08
                                      1-09
  0-09               .DS450         SEE ABOVE         16851
  0-12               .DS191           0-13            55524
                                      1-12
                                      1-13
  0-13               .DS191         SEE ABOVE          2479
  0-16               .DS181           0-17             8290
                                      1-16
                                      1-17
  0-18               .DMTA9           NONE               62
  0-19               .DMTA9           NONE             9147

      (IN THE ACTUAL REPORT A SUMMARY OF IOM NUMBER 1 REPORT WOULD FOLLOW)
```

Figure 7-1. System Configuration and Channel Usage Report

monitors that were active during data collection. The monitor name is given, its CPU time in seconds, and its overhead as a function of total processor power. The GMF executive overhead is separated from the actual monitors and is listed as "EXEC". The monitor "NAME" is an area of code within the Mass Store Monitor and even though listed separately it is also included under the monitor "MSM". The monitor "FMS" is also an area of code within the Mass Store Monitor, but in this case it has not been included under the monitor "MSM".

Monitor "CM" in this report describes the processor overhead of subroutine T4 (terminate processing) and subroutine T22 (start I/O processing). Monitor "MSM" in this report describes the processor overhead of subroutine T7 (connect processing). Therefore, if the Channel Monitor was active, but the Mass Store Monitor was not, this report will still list both "CM" and "MSM" as contributing to the processor overhead. The total Channel Monitor overhead will be found by adding the overhead of the "CM" monitor to the overhead of the "MSM" monitor, to the overhead of the "FMS" monitor.

If both the Channel Monitor and Mass Store Monitor were active, then the combined overhead of both monitors can be found as the sum of "MSM" + "CM" + "FMS".

For purposes of this report, % overhead is computed as:

$$\frac{\text{(CPU TIME Used by Monitor)}}{\text{(TOTAL Elapsed Time)x(Number of Processors)}}$$

Following the overhead description are three lines of configuration information describing the number of processors, IOMs, and amount of memory configured to the system. In addition, the size of GCOS Hard Core, the size of the Core Allocator and the size of FILSYS is also presented. The third line of the configuration data indicates the number of processors actually configured and actually available. These numbers might be different than shown on the first line due to the assigning and releasing of processors. In figure 7-1, we see that one processor was released for a period of time (i.e., CPUs actually available is equal to 1.75). The actual time that processors were available or released is indicated in the status message printouts (see subsection 7.5.25).

The next portion of the report documents the channel configuration by IOM, listing each configured channel number, the device type configured to that channel, and the channel crossbarring. The crossbar column shows those channels that are crossbarred to the channel identified under the channel column. If SEE ABOVE is found, the crossbarring has been displayed on a preceding channel. The I-CC format of each channel description identifies the IOM and the channel number being discussed. The last column of this report displays the number of all connect types issued over that channel. This section will be repeated for each IOM configured to the system. Figure 7-1 only displays IOM 0 activity. This report is always generated and cannot be turned off.

```
***********************************************************************
* * *       M S M   S Y S T E M   S U M M A R Y   R E P O R T     * * *
***********************************************************************

TOTAL CONNECTS TO DSS181           8540 OF     207117 ( 4%) AT A RATE OF       12024. PER HOUR
TOTAL CONNECTS TO DSS191          76949 OF     207117 (37%) AT A RATE OF      108341. PER HOUR
TOTAL CONNECTS TO MS0450         107273 OF     207117 (51%) AT A RATE OF      151036. PER HOUR
TOTAL CONNECTS TO MPC-CONTROL        12 OF     207117 ( 0%) AT A RATE OF          16. PER HOUR

                                 COMMANDS PER CHANNEL
                                     IOM NUMBER 0

  CHANNEL            8          9          12          13          16     17
  COUNT          47750      16851       55524        2479        8290      0
                                     IOM NUMBER 0

  CHANNEL            8          9          12          13          16     17
  COUNT          38189       4487       18773         177         254      0

                         COMMAND                     COUNT
                      01 CONTRL                         12
                      17 FMT TK                      15485
                      25 READ                       126899
                      26 RD CR                         192
                      31 WRITE                       35483
                      33 WR-VER                      12862
                      40 RST ST                       1841
                      TOTAL                         192774
```

Figure 7-2. MSM System Summary Report

7.5.2 System Summary Report (File 42). The Sytem Configuration and Channel Usage Report and the System Summary Report may be used to assess overall system utilization. Figure 7-2 is an example of the System Summary Report. The first set of lines shows the number of connects to the monitored mass storage subsystems compared to the total connects issued (TAPE+DISK) and the connect rate per hour over the subsystem. Most systems will show a small number of Control Connects being generated by the MPCs configured to the system. These Control Connects will be summed together and listed as a separate subsystem line. Analysis on a Shared Mass Storage System shows the number of MPC connects generated to be a significant percentage of the total connects generated. The next lines show the breakdown of the mass storage connects by the IOM channel over which they were issued. The final part of this report is a list of the commands (octal code and mnemonic) issued to the mass storage subsystem and the count of each issued during the monitoring session. This report is always generated and cannot be turned off.

A well performing system, under a heavy workload, should show a high utilization of the configured resources. Figure 7-2 shows that the I/O activity is predominantly on the MSU450 subsystem configured on channels 8 and 9 of IOM 0 and 1 (see figure 7-1). The MSU450s are receiving 51% of all connects and, therefore, should be the major area of concern. The access rate for every subsystem is reported on the top of the System Summary Report and it can be seen that the MSU450s have an access rate significantly higher than the other subsystems. All signs indicate that if system throughput is being affected by disk activity, then the MSU450s would be the probable cause of such problems.

The next item to check on these two reports should be the channel usage. The two highest used logical channels of any subsystem should be on a separate PSI channel of a two-PSI channel subsystem. Referring to figure 7-2, one can see that logical channel 8 of IOM 0 and IOM 1 has the highest usage, and this is the proper configuration. If the highest used logical channels are not on separate PSI channels, the $ XBAR card in the startup configuration section is suspected as the cause. The channels are used in the order given on the $ XBAR card (i.e., if the primary channel is busy, the next channel tried is given on the crossbar). The alternate use of PSI channels for maximum simultaneity must, therefore, be appropriately specified in the boot deck.

While looking at the System Summary Report, it is also of interest to note the ratio of READ commands to WRITE commands (over two to one in this example). This gives an indication of the nature of the usage of the mass storage space. A quick look at the number of write/verify (WR-VER) commands executed is also of interest as they are essentially double (WRITE, then READ) data transfer commands which require more device and channel time.

The general fraction of utilization for each logical channel gives an indication of the degree of simultaneity of access to the subsystem. If only N of the configured logical channels have nonzero counts, then there were never more than N accesses being performed simultaneously by the

subsystem. The proportional relationships among the counts of accesses made over each of the logical channels are quantitative indications of the frequency of occurrence of specific levels of simultaneity. As an example, if we look at figure 7-2, we see that only 4487 connects out a total of 107,273 connects went to Channel 9, IOM 1. This means that only 4487 times during the measuring period were all four MSU450 disk channels being utilized simultaneously. In this example, channel queuing (i.e., shortage of channel power) would not appear to be a problem. This is not to infer that device queuing is not a problem, just that channel queuing does not appear to be a problem. If the number of accesses to the lowest priority channel is a larger percentage of the total accesses, then channel queuing needs to be examined. Queuing for devices and/or channels can be analyzed by running the Channel Monitor Data Reduction Program (see section 8).

7.5.3 System Traces Captured by Monitor Report (File 42). This report contains the number of occurrences of each specific trace type record on the data collector tape processed by the MSMDRP (figure 7-3). This report provides little, if any, information required by the user for his analysis. This report is always generated and cannot be turned off.

7.5.4 Channel Status Changes Report (File 29). This report lists the initial status for all tape and disk channels configured to the system (figure 7-4). If, during the course of the monitoring session, a given channel or IOM was dropped or added to the system (dynamic reconfiguration) a new report will be produced indicating the activation of deactivation changes and the time that the change occurred. Finally, this report will indicate whether the SSA cache option and FMS cache option are active, and if so, will indicate their initial status and any changes that occur to that status. If a given option is not active, a zero will be reported for each of the values. This report is always generated and cannot be turned off.

7.5.5 Physical Device, Device ID Correlation Table (File 42). Each mass storage device configured in the system is listed with a unique device ID. A typical report is presented in figure 7-5. This unique device is needed since different devices can have the same device number on the Honeywell 6000. (See Device ID 1, Device ID 7, and Device ID 18 of figure 7-5). These unique numbers are referenced in several reports produced by the MSMDRP. This report is always generated and cannot be turned off.

7.5.6 Device Space Utilization Report (File 42). The device space utilization histogram report is produced for every device on the mass storage subsystem and shows the distribution of access to the device space. Figure 7-6 is an example. It should be noted that the name of the device is also given. This example presents all connects made to the device with the name RF5. If an exchange took place and the RF5 disk pack was moved from 0-08-05 to 0-08-01 the data reduction program will account for that exchange and any connects that are made to 0-08-01 will be

SYSTEM TRACES CAPTURED BY MONITOR REPORT

TRACE	COUNT	TRACE	COUNT	TRACE	COUNT	TRACE	COUNT	TRACE	COUNT	TRACE	COUNT	TRACE	COUNT	TRACE	COUNT
00	0	01	0	02	0	03	0	04	3214	05	0	06	0	07	3214
10	129	11	0	12	0	13	0	14	636	15	0	16	0	17	0
20	0	21	450	22	3214	23	0	24	0	25	0	26	0	27	0
30	0	31	0	32	0	33	0	34	0	35	0	36	0	37	0
40	0	41	0	42	0	43	0	44	0	45	0	46	15	47	0
50	21	51	0	52	0	53	0	54	0	55	0	56	0	57	0
60	0	61	0	62	0	63	0	64	0	65	0	66	0	67	0
70	0	71	0	72	0	73	0	74	0	75	0	76	0	77	0

Figure 7-3. System Traces Captured by Monitor Report

CHANNEL STATUS CHANGES REPORT FOR NMCC2 ON 80/09/20

IOM	CHANNEL	DEACTIVATE/ACTIVATE CHANGE	TIME
0	08	INITIAL ACTIVE	16:50:49.7
0	09	INITIAL ACTIVE	16:50:49.7
0	12	INITIAL ACTIVE	16:50:49.7
0	13	INITIAL ACTIVE	16:50:49.7
0	14	INITIAL ACTIVE	16:50:49.7
0	15	INITIAL ACTIVE	16:50:49.7
0	16	INITIAL ACTIVE	16:50:49.7
0	17	INITIAL ACTIVE	16:50:49.7
0	18	INITIAL ACTIVE	16:50:49.7
1	08	INITIAL ACTIVE	16:50:49.7
1	09	INITIAL ACTIVE	16:50:49.7
1	12	INITIAL ACTIVE	16:50:49.7
1	13	INITIAL ACTIVE	16:50:49.7
1	14	INITIAL ACTIVE	16:50:49.7
1	15	INITIAL ACTIVE	16:50:49.7
1	16	INITIAL ACTIVE	16:50:49.7
1	17	INITIAL ACTIVE	16:50:49.7

INITIAL VALUES FOR SSA CACHE - LAL, MBA, SIZE
000000200000 000000001566 10

INITIAL VALUES FOR FMS CACHE - ABS ADDR, MBA, OPTION WORD, #320 WORD BUFFERS
000000000000 000000000000 000000000000 0

Figure 7-4. Channel Status Changes Report

THE PHYSICAL DEVICE, DEVICE ID CORRELATION TABLE

```
DEVICE ID - 1 IS FOUND ON IOM-0 PUB-08 AND IS DEVICE #01
DEVICE ID - 2 IS FOUND ON IOM-0 PUB-08 AND IS DEVICE #02
DEVICE ID - 3 IS FOUND ON IOM-0 PUB-08 AND IS DEVICE #03
DEVICE ID - 4 IS FOUND ON IOM-0 PUB-08 AND IS DEVICE #04
DEVICE ID - 5 IS FOUND ON IOM-0 PUB-08 AND IS DEVICE #05
DEVICE ID - 6 IS FOUND ON IOM-0 PUB-08 AND IS DEVICE #06
DEVICE ID - 7 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #01
DEVICE ID - 8 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #02
DEVICE ID - 9 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #03
DEVICE ID -10 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #04
DEVICE ID -11 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #05
DEVICE ID -12 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #06
DEVICE ID -13 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #07
DEVICE ID -14 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #08
DEVICE ID -15 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #09
DEVICE ID -16 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #10
DEVICE ID -17 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #11
DEVICE ID -18 IS FOUND ON IOM-0 PUB-16 AND IS DEVICE #01
DEVICE ID -19 IS FOUND ON IOM-0 PUB-16 AND IS DEVICE #02
DEVICE ID -20 IS FOUND ON IOM-0 PUB-16 AND IS DEVICE #03
DEVICE ID -21 IS FOUND ON IOM-0 PUB-16 AND IS DEVICE #04
DEVICE ID -22 IS FOUND ON IOM-0 PUB-16 AND IS DEVICE #05
DEVICE ID -23 IS FOUND ON IOM-0 PUB-16 AND IS DEVICE #06
DEVICE ID -24 IS FOUND ON IOM-0 PUB-16 AND IS DEVICE #07
```

Figure 7-5. Physical Device, Device ID Correlation Table

```
                    DISTRIBUTION COLLECTED ON SYSTEM NMCC2  AT 18:36:38 ON 81-03-13

                         SPACE UTILIZATION OF IOM-0,PUB-08,DEVICE-05-- MS0450         RF5

INDIV.    CUMUL.    CUMUL.    INDIV.   CYLNDR                 PERCENT OF OCCURRENCE                 REPORT
NUMBER    NUMBER    PRC.      PRC.     NUMBER   00   05   10   15   20   25   30   35   40   45   50    49
                                                 I....I....I....I....I....I....I....I....I....I....I
 564        564     27.606    27.606     0-  16  Ixxxxxxxxxxxxxxxxxxxxxxxxxxxx
  67        631     30.886     3.279    17-  33  Ixxx
 207        838     41.018    10.132    34-  50  Ixxxxxxxxx
   0        838     41.018     0.       51-  67  I
   0        838     41.018     0.       68-  84  I
   0        838     41.018     0.       85- 101  I
   0        838     41.108     0.      102- 118  I
  21        859     42.046     1.028   119- 135  Ix
   .         .         .         .       .    .  .
   .         .         .         .       .    .  .
   .         .         .         .       .    .  .
   2        998     48.850     0.098   663- 679  I
 220       1218     59.618    10.768   680- 696  Ixxxxxxxxxxx
   0       1218     59.618     0.      697- 713  I
 213       1431     70.044    10.426   714- 730  Ixxxxxxxxxx
   0       1431     70.044     0.      731- 747  I
 612       2043    100.000    29.956   748- 764  Ixxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

2043 ENTRIES TOTAL      AVERAGE =   408.11160    VARIANCE =   121836.060     STANDARD DEVIATION =   349.050
```

Figure 7-6. Device Space Utilization Report

reported on this histogram and not to the 0-08-01 histogram. Entries in the column headed CYLNDR NUMBER give the range of cylinders which form each histogram bucket. The number of cylinders in each bucket is a function of the device type. The entries in the column headed INDIV. NUMBER give the number of accesses made to that device within the physical space defined by the range of cylinders.

Similarly, the columns headed INDIV. PRC and CUMUL. PRC give the individual and cumulative percentages of all accesses to that device which were made within each cylinder range. The graphic portion of the display gives a visual indication of the percentage of accesses which were made for each range of the device space. This helps to quickly assess the access pattern of the usage for the device, i.e., whether the device is totally allocated and used or locally used. Figure 7-6 shows a device whose usage is split between two extremes. Such a situation should be investigated.

In the upper right hand corner of the report, a report number is indicated. This report number is used only to distinguish one histogram from another and in no way indicates the device to which the report refers. In addition, report numbers may not appear sequentially and this, in no way, is indicative of a problem. This report is always generated and cannot be turned off.

7.5.7 Device Seek Movement Report (File 42). The seek movement histogram is produced for devices in the mass storage subsystem being analyzed and provides the distribution of distance traveled by the read mechanism. Figure 7-7 is an example. The data used to generate this report is the absolute value of the difference between the cylinder addresses of each successive access to the given device. The column headed CYLNDR MOVED contains the range of seek movement distance for each line of the report. The column headed INDIV. NUMBER contains the counts of the number of accesses which caused the arm to be moved that distance. Figure 7-7 shows 854 accesses caused no arm movement (the same cylinder was successively accessed) for IOM-0 Device 05 on PUB 8. The INDV. PRC and CUMUL. PRC columns give the individual and cumulative percentages of the accesses to that device which resulted in a particular range of seek movement.

Figure 7-7 shows, for example, that 263 (12.8 percent) of the accesses caused arm movement in the range of 714 to 730 cylinders and that 1313 (64.2 percent) of the arm movements were a distance of 16 cylinders or less. The statistics at the bottom of this report give the characterization of the seeking characteristics of the files being accessed on this device during the monitoring period. The minimum movement, maximum movement, average, variance, and standard deviation are included. This report is always generated and cannot be turned off.

The Device Space Utilization Report (figure 7-6) shows that most of the accessing was concentrated in two areas on the device (cylinders 0-50 and

```
                       DISTRIBUTION COLLECTED ON SYSTEM NMCC2  AT 18:36:38 ON 81-03-13

                               SEEK MOVEMENT OF IOM-0,PUB-08,DEVICE-05-- MS0450           RF5

INDIV.    CUMUL.    CUMUL.    INDIV.   CYLNDR               PERCENT OF OCCURRENCE                      REPORT
NUMBER    NUMBER    PRC.      PRC.     NUMBER    00   05   10   15   20   25   30   35   40   45   50     50
                                                  I....I....I....I....I....I....I....I....I....I....I
 854        854     41.801    41.801     0-   0  Ixxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
 459       1313     64.268    22.467     1-  16  Ixxxxxxxxxxxxxxxxxxxxxx
 118       1431     70.044     5.776    17-  33  Ixxxxxx
  63       1494     73.128     3.084    34-  50  Ixxx
  17       1511     73.960     0.832    51-  67  Ix
   5       1516     74.205     0.245    68-  84  I
   7       1523     74.547     0.343    85- 101  I
  10       1533     75.037     0.489   102- 118  I
   1       1534     75.086     0.049   119- 135  I
  18       1552     75.967     0.881   136- 152  Ix
   .          .        .         .       .    .  .
   .          .        .         .       .    .  .
   .          .        .         .       .    .  .
  10       1633     79.931     0.489   663- 679  I
  36       1669     81.694     1.762   680- 696  Ixx
   2       1671     81.791     0.098   697- 713  I
 263       1934     94.665    12.873   714- 730  Ixxxxxxxxxxxxx
   2       1936     94.763     0.098   731- 747  I
 107       2043    100.000     5.237   748- 764  Ixxxxx

2043 ENTRIES TOTAL      AVERAGE =   167.63534     VARIANCE =   85389.356     STANDARD DEVIATION =   292.215
```

Figure 7-7. Device Seek Movement Report

680-764). This is not necessarily bad, but if "interlaced" accessing was between these two areas, many seeks of about 700 cylinders would result. If, on the other hand, accessing to one area was completed before accessing to another began, there would be no large number of movement seeks. In this case, the example in figure 7-7 shows 18 percent of the seeks to be across a distance of 714-764 cylinders. This represents a situation where the particular files and jobs may need to be identified so that methods for reducing the number of movement seeks may be found and implemented for performance improvement. Further confirmation of this problem could be found by analyzing the Head Movement Efficiency Report (see subsection 7.5.8 and figure 7-8). If a problem exists then the connects/arm movement column for this particular device should approach a value of one. This figure indicates how many connects are issued between each movement of the arm. Therefore, even though we may have long seeks occurring on the device, if a large number of connects are being processed between these seeks, this would tend to lessen the impact of the long seeks.

For the Device Space Utilization Report and Device Seek Movement Report, an entry is made only for multi-command connects (see subsection 7.3) such as a seek/read or seek/write. If the first command of an IO connect is not a seek, or pre-seek, then an entry will not be made to this set of histograms. For this reason, the number of connects reported in these reports, for a given device, may be somewhat lower than that reported in the Proportionate Device Utilization Histogram, described in subsection 7.5.20. In addition to not recording non-multicommands such as controller commands and reset status commands, there are also a significant number of multicommands that are issued by the system for which the system does not generate a "valid" seek address in the "normal" manner. These connects will not be reported in the Space Utilization or Seek Movement histograms, but will be reported in the Proportionate Device Utilization Histogram. Research is currently underway to determine under what conditions these "nonvalid" seek address I/O requests are generated and whether there is any procedure by which the MSM could determine the correct seek address (see subsection 7.3).

7.5.8 Head Movement Efficiency Report (File 42). This report displays how many connects are issued per arm movement of the device. Figure 7-8 is an example. The first three columns give the IOM, Channel, and Device number of the device. This is followed by the number of connects issued to that device and the number of times any arm movement was required (size of the seek is not considered). The final column indicates the ratio of connects to arm movements. The larger this ratio is, the more efficient is the device (i.e., the larger is the number of connects being handled between each arm movement of the device). Following the breakdown of arm movement by individual device, a summary is presented for arm movement within each individual mass storage subsystem. This is followed by three lines of output summarizing the overall efficiency of the entire disk subsystem. The first line presents the total number of connects issued, the second

MSM HEAD MOVEMENT EFFICIENCY REPORT FOR SYSTEM NMCC ON 81-12-07

IOM	PUB	DEVICE	CONNECTS	ARM MOVES	CONNECTS/ARM MOVEMENT
0	08	01	34848	28491	1.223
0	08	02	21479	8673	2.477
0	08	03	30030	18410	1.631
0	08	04	31128	19449	1.600
0	08	05	0	1	0.
0	08	06	220	1	220.000
0	12	01	6449	3138	2.055
0	12	02	2520	86	29.302
0	12	03	2048	549	3.730
0	12	04	3303	562	5.877
0	12	05	4818	1887	2.553
0	12	06	2929	754	3.885
0	12	07	220	1	220.000
0	12	08	4824	1479	3.262
0	12	09	9145	3303	2.769
0	12	10	3249	690	4.709
0	12	11	2285	754	3.031
0	16	01	0	1	0.
0	16	02	0	1	0.
0	16	03	12	1	12.000
0	16	04	3754	168	22.345
0	16	05	260	12	12.667
0	16	06	220	1	220.000
0	16	07	220	1	220.000

DEVICE TYPE	CONNECTS	ARM MOVES	CONNECTS/ARM MOVEMENT
.DS181	4466	185	24.141
.DS191	41790	13203	3.165
.DS450	117705	75025	1.569

TOTAL MASS STORAGE CONNECTS	163961
TOTAL ARM MOVEMENTS	88413
HEAD MOVEMENT EFFICIENCY	1.854

Figure 7-8. Head Movement Efficiency Report

line presents the total number of arm movements, irrespective of the number of cylinders traversed by each movement, and the final line presents the overall head movement efficiency (line 1 divided by line 2). The only connects reported in this report are those multicommand connects for which the MSM was able to determine a "valid" seek address (see subsection 7-3). By examining figure 7-8, the user will observe that the MSU450s appear to be least efficient, with the exception of device number 2. This report is always generated and cannot be turned off.

7.5.9 System File Use Summary Report (File 21). This report indicates where each system file is located and to what extent it was accessed across the measurement session. Only those files accessed are displayed. Figure 7-9 shows an example of this report. This report is produced by default but can be turned off with the input option (OFF) (subsection 7.6.9). The sum of accesses to all system files is then expressed as a percentage of all mass storage accesses. The system files are those files defined, via startup in the .CRDIT table. As can be seen in figure 7-9, the file names listed under the File Name column are not the actual file name, but rather relative file names indicative of their position description within the startup deck. Actual file names can be output in this report if the user selects the input option described in subsection 7.6.4. The connects reported are multicommand in nature and contain a "valid" seek-address as captured by the MSM. (See subsection 7.3).

This list of system files is then followed by a list of modules which reside in hard core because they are hard core modules or because they have been loaded into hard core by system personnel in order to save on I/O processing. If a system module is not loaded in hard core, and is required for some processing, then the system must perform an IO function to read this module from disk into a user's SSA work space. A significant amount of such system IO can cause severe system degradation. This degradation can be reduced by placing additional system modules in hard core or else by increasing the size of SSA Cache Memory. The System File Use Summary Report and the following Individual Module Activity Report should provide sufficient information to determine whether user action is required to reduce system IO overhead. If the percentage of system IO reported in this report is greater than 5-7%, then some user action is probably required. If addtional hard core space is available, the user should move as many system modules as possible into hard core. Each hard core module requires 1/2K (512 words) of memory, and there is 64K of hard core memory available. The System Configuration and Channel Usage Report (subsection 7.5.1) indicates the amount of hard core currently in use. The Individual Module Activity Report (subsection 7.5.10) can be used to indicate which system modules should be transferred to hard core. If sufficient hard core is not available, then the size of SSA cache should probably be increased. Once again, the Individual Module Activity Report should be referenced to see if this type of action would aid in reducing system IO.

MSM SYSTEM FILE USE SUMMARY REPORT FOR SYSTEM NMCC ON 81-12-07

FILE NUMBER	FILE NAME	IOM-PUB-DEV	STARTING SECTOR/CYLINDER	LENGTH (SECTOR)	ACCESSES
1	SYSTEM FILE1	0- 8- 1	107480/ 141	500	1
2	SYSTEM FILE2	0- 8- 2	40/ 0	5000	2
3	SYSTEM FILE3	0- 8- 2	6300/ 8	2500	62
4	SYSTEM FILE4	0- 8- 1	11040/ 14	4000	16318
5	SYSTEM FILE5	0- 8- 2	13300/ 17	10000	2569
6	SYSTEM FILE6	0-12- 7	40/ 0	4500	14
7	SYSTEM FILE7	0- 8- 1	15040/ 19	7600	421
9	SYSTEM FILE9	0-12- 7	9500/ 12	16000	854
10	SYSTEM FILE10	0-12- 7	25500/ 33	12000	491
				TOTAL	21678(13%)

.MBRT1	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MCPIO	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MDISP	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MDNET	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MDUMP	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MFALT	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MGEPR	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MSCM1	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MGP01	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MGPIO	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MIDSC	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MIOS	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MMTAP	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MPRIO	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MROUT	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MSYOT	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MTYPE	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MDSX1	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MDSX5	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MDSX6	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MFSIO	LOADED BY STARTUP	TYPE IS	HRD CORE MOD
.MSECR	LOADED BY STARTUP	TYPE IS	HRD CORE MOD

Figure 7-9. System File Use Summary Report

7.5.10 Individual Module Activity Report (File 21). This report shows the accessing done to each system module (figure 7-10). The report presents the system file the module resides in, followed by the module name and type. The module location, access count, and percentage of system file usage is then given. The last two entries give the total number of SSA CACHE buffer hits and disk loads this module accumulated (these values are 0 if SSA CACHE is not active). A minus one in column indicates a nonstandard SSA module. The Number of Accesses column reports the number of connects made to this SSA module as determined by the issuance of a trace type 7. The Disk Load column reports the number of times the SSA CACHE logic claims to have issued a connect to this SSA module. In those cases where no lost data occurred during the monitoring session and a GMC termination record was generated (i.e., GMC terminated correctly), these two columns should display equal values. Figure 7-10 shows this to be the case for almost all of the SSA modules. However, there are some exceptions. Module .MALC6 shows 109 accesses but only 104 disk loads (i.e., a difference of five). This apparent inconsistency has been reported to Honeywell, and an explanation requested.

If lost data occurred during the monitoring session (i.e., trace type 7 data lost), the Number of Accesses column could be significantly lower than the Disk Load column. If, on the other hand, GMC did not abort cleanly and a termination record was not generated, the Disk Load column could be significantly lower than the Number of Accesses column.

Finally, it should be noted that data from the last two columns pertains only to "STANDARD SSA" modules (see the Type column). Modules that are typed as "ABSOLUTE" or "EXCEPT PROC" are not placed into SSA Cache Core and therefore do not generate values for the last two columns. This report is produced by default but can be turned off with the input option (OFF) (subsection 7.6.9).

When generating this report, the data reduction program creates a temporary file (file code 55) which is used to produce a Job SSA Module Usage Report (subsection 7.5.11). If this report is desired, the report must be requested via input option (MODULE) (subsection 7.6.6).

At the bottom of this report, a summary line is produced indicating the percentage of buffer hits and disk loads. If the percentage of buffer hits is less than 90, then the size of SSA cache should be increased. For each 1K increase, 2 additional modules will be loaded into the SSA Cache memory.

When using this report to determine which additional SSA modules should be placed into GCOS Hard Core, the user should reference the "% of Activity" column. Those modules with the largest reported figure would be candidates for movement. In figure 7-10, .MALC6, .MALC9, .MFS03, .MFS04 would be candidates for movement.

MSM INDIVIDUAL MODULE ACTIVITY REPORT FOR NMCC ON 81-12-07

SYSTEM FILE	MODULE NAME	TYPE	IOM-PUB-DEVICE	SECTOR IN FILE	NUMBER ACCESSES	% OF ACTIVITY	BUFFER HITS	DISK LOADS
SYSTEM FILE4	.MAC02	STANDARD SSA	0- 8- 1	180	44	1	42	44
SYSTEM FILE4	.MALC2	STANDARD SSA	0- 8- 1	452	11	0	23	11
SYSTEM FILE4	.MALC5	STANDARD SSA	0- 8- 1	473	21	0	18	21
SYSTEM FILE4	.MALC6	STANDARD SSA	0- 8- 1	482	109	2	77	104
SYSTEM FILE4	.MALC9	STANDARD SSA	0- 8- 1	501	101	2	83	95
SYSTEM FILE4	.MBRT2	STANDARD SSA	0- 8- 1	670	12	0	3	12
SYSTEM FILE4	.MBRT3	STANDARD SSA	0- 8- 1	679	3	0	0	0
SYSTEM FILE4	.MBRT5	ABSOLUTE PRG	0- 8- 1	697	2	0	0	0
SYSTEM FILE4	.MBRT6	ABSOLUTE PRG	0- 8- 1	729	26	0	0	0
SYSTEM FILE4	.MCAL1	STANDARD SSA	0- 8- 1	831	20	0	858	20
SYSTEM FILE4	.MCAL2	STANDARD SSA	0- 8- 1	840	1	0	0	1
SYSTEM FILE4	.MFLT1	STANDARD SSA	0- 8- 1	1332	78	1	1402	77
SYSTEM FILE4	.MFS03	STANDARD SSA	0- 8- 1	1361	101	2	182	93
SYSTEM FILE4	.MFS04	STANDARD SSA	0- 8- 1	1370	99	2	30	93
SYSTEM FILE4	.MFS06	STANDARD SSA	0- 8- 1	1388	19	0	4	19
SYSTEM FILE4	.MFS08	STANDARD SSA	0- 8- 1	1406	18	0	37	18
SYSTEM FILE4	.MFS09	STANDARD SSA	0- 8- 1	1415	57	1	526	52
.								
.								
.								
.								
				TOTAL			76357	33455
				% HITS, LOADS/HITS + LOADS			69.53	30.47

Figure 7-10. Individual Module Activity Report

7.5.11 SSA Module Usage Report by Job (File 21). When requested by the user, this report will produced a listing for every job run during the monitoring period, showing all SSA modules referenced by that job and the number of such references. An example is shown in figure 7-11. This is the best method to use when determining which SSA modules should be softloaded into TSS core. This also provides an excellent means for studying the usage of SSA modules in general. This report is off by default and must be requested with a user input option (MODULE) (subsection 7.6.6).

7.5.12 File Code Summary Report (File 23) (NAME=FILECODE). The File Code Summary Report lists, by each activity, the files allocated to mass storage, their location and size, and the number of accesses made to each in the system during the monitoring period. Figure 7-12 is an example of this report. The activities in this report are in the same order as they appear in the Activity Summary Report (see subsection 7.5.15).

Each activity is identified by its SNUMB, activity number, and $ IDENT and USERID cards. There are as many data lines as necessary to describe each mass storage file used by the activity and the number of times the file was accessed. There is one line per file, and the file is described by its two-character file code, the device on which it was allocated (ALLOCATED DEVICE), its origin on that device (FILE ORIGIN) in units of LLINKS (320 words) and cylinders relative to the beginning of the device, and the size of the file (FILE SIZE) in LLINKS and cylinders. The column headed CONNECTS gives the count of the number of accesses made to the file.

There are several special file codes that will appear in this report. The following file codes will appear for almost every activity that is processed:

00 - Mass storage accesses made without a normal PAT entry; e.g., accesses made by the operating system as part of job intialization which are done without a PAT for efficiency

-- - All accesses to SYSOUT

=9 - File grow, PAT refresh, permanent allocation

=1 - Temporary allocation

0% - Load, pop, or push of an SSA

*, - FILSYS catalog search connect

It should be realized that these file codes are not used for a unique file request, and therefore may actually reference several different files. Therefore, in figure 7-12 it can be seen that activity 1 for SNUMB 2802T

DATA COLLECTED ON 81-12-25 AT 18:06

SNUMB	MODULE	# ACCESSES	MODULE	# ACCESSES	MODULE	# ACCESSES	MODULE	# ACCESSES
3625T	.MCAL1	7	DIRXLT	1	DDLXLT	1	.MFLT1	15
3625T	.MFLT2	11	.MMORE	5	.MAC10	7	.MFS09	17
3625T	.MFS03	8	.MFS36	4	.MFS15	4	.MFS61	8
3625T	.MFS73	10	.MFS37	4	.MRELS	4	.MREL1	3
3625T	.MFS04	24	.MFS13	2	.MSY11	11	.MSYT2	2
3625T	.MSYT3	2	.MIOS1	3	.MBRT2	3	.MFS27	2
3625T	.MGP23	2	.MBRT6	2	.MALC9	3	DBUG	1
3625T	.MMOR1	1	.MFS19	1	.MFS34	1	.MALC5	1
3625T	.MFS49	1	.MALC7	1	.MFS23	1	.MFS18	1
3625T	.MSNP1	2						
3637T	.MCAL1	6	ECFR	1	.MFS09	4	.MFLT1	2
3637T	.MFLT2	1	.MFS08	6	.MFS68	2	.MSYT2	5
3637T	.MSYT3	2	.MIOS1	1	.MBRT2	1	.MSYT1	4
3637T	.MFS27	1	.MGP23	1	.MBRT6	1	.MAL09	2

Figure 7-11. SSA Module Usage Report By Job

FILE CODE SUMMARY REPORT FOR SYSTEM NMCC ON 81-12-01

```
SNUMB,ACTVY #,IDENT,USERID  2802T- 1    1820513/10/4804/FORDI,KONKEL                                 674IDP00
-----------------------------------           FILE  SIZE        ALLOCATED      FILE ORIGIN
      FILE CODE       CONNECTS              (LLINK/CYLINDER)     DEVICE      (LLINK/CYLINDER)
       00                479                     0/  0           1-10- 2          0/  0
       *1 T S N F         76                    48/  1           0-12- 1       44361/291
       B* T S N F        145                    72/  1           0-12- 9       26085/171
       -- P R N F         53                     0/  0           0-12- 7          0/  0
       *Z T R N F         83                    60/  1           0-12- 4       48778/320
       *C P S C F         44                   139/  1           1- 8-13       23523/154
       S* T S N F        157                    72/  1           0-12- 4       48263/317
       K* T S N F         36                   600/  4           2- 9-10       50649/333
       D* P S N F          8                     1/  1           1- 8- 9       46522/306
       *5 T S N F         38                    36/  1           0-12-10       29611/194
       R* P S C F         61                    65/  1           0-13- 8       23364/153
       *4 T S N F          2                    12/  1           0-12-11       48662/320
       *J T R N F          1                     0/  0           1-10- 9       46518/306

SNUMB,ACTVY #,IDENT,USERID  2760T- 3    1820615/30/4955/GFEH*                                        220IDP11
-----------------------------------           FILE  SIZE        ALLOCATED      FILE ORIGIN
      FILE CODE       CONNECTS              (LLINK/CYLINDER)     DEVICE      (LLINK/CYLINDER)
       20 T R N F          1                   420/  3           0- 8- 4       51921/341
       00                 81                     0/  0           1- 8- 2          0/  0
       02 T R N F        384                   180/  2           0- 8- 8       61573/405
       05 P S C F          3                    14/  1           0- 8- 7       25274/166
       03 T S N F         20                  1200/  8           0- 8- 7       49663/326
       01 T R N F         36                   240/  2           0- 8- 7       47671/313
       -- P R N F         44                     0/  0           0- 8-12          0/  0
       10 T R N F        290                   240/  2           1-10-10       22349/147
       04 P S N F          1                     1/  1           0- 8- 7       49383/324
       12 T R N F          2                   240/  2           0- 8- 4       51681/340
       09 T S N F          2                  1200/  8           0- 8- 8       46470/305
       18 T S N F          2                    60/  1           1- 8-13       49109/323
       15 T S N F          2                    60/  1           0-10-10       25549/168
       19 T R N F          1                   300/  2           0- 8- 2       48910/321
       *J T R N F          1                     0/  0           1- 8- 7       49378/324
```

Figure 7-12. File Code Summary Report

made 479 connects to file code 00 located on device 1-10-2. In actuality, the activity may have connected to several different devices, each time referencing this special file code. Instead of reporting these connects as separate entries, all the requests are grouped, and the allocated device that is reported is the the one that was referenced by the first of the 479 connects. There is a user option available (AREA) that expands the usage definition of these file codes. This option will then display all files using these file codes rather than grouping all of the unique file codes into a single collection file code.

The file code report for the TSS subsystem will also contain several special file codes. Following is a list of these:

TU - user files requested under TSS subsystems.
<< - file code referenced by TSS that contains a character that cannot be printed. The << symbol is being used instead.
JO - TSS I/O to this file code is JOUT processing.

This report will record all accesses to a file that is made with a multicommand request. No check is made to determine if a valid seek address has been recorded. (See subsection 7.3).

This report may produce excessive output and therefore is not produced under default conditions. The user must explicitly request this report with the use of an input option (ON) (see subsection 7.6.10).

Each file code entry has information which indicates the type of file by a "P" for permanent and "T" for temporary. This entry is located on the right side of the file code characters. Immediately to the right of the file type character is the access characteristics of the file. This is denoted by an "R" if random, or an "S" for a sequential file. The next character defines a permanent file as cataloged, "C", or noncataloged, "N". This character for a temporary file will be a blank as it is neither cataloged nor noncataloged. GCOS files are usually defined as noncataloged, permanent files and are treated at startup time much like permanent files by the file system. They are not, however, given the allocation treatment during normal operation time that is given to permanent files. The final character is an "F" for fixed or an "R" for removable.

7.5.13 Cat/File String Report (File 23). Immediately following the File Code Summary Report, the user will find the CAT/File String Report (figure 7-13). This report will provide the CAT/File String for every permanent user file referenced during execution. It will not list the CAT/File String for any special system files. In addition, it will indicate the total number of connects required to locate the file (catalog searching) every time the system was required to search for that file via a MME GEFSYE. Finally, it will indicate the number of connects required to

CAT/FILE STRING REPORT

SNUMB-ACT	FILE CODE	CONNECTS	CONN/GFYS	CAT/FILE STRING
8174T- 0	H*	70	10.000	A16IDPXO/HSTAR/H.DMS/
8174T- 0	H*	10	10.000	A16IDPXO/HSTAR/H.MSFMAC/
8174T- 0	H*	9	9.000	A16IDPXO/HSTAR/H.MSFMOD/
8174T- 0	PL	12	4.000	A16IDPXO/LINK/PLUSLIB/
8174T- 3	H*	20	10.000	A16IDPXO/HSTAR/H.DMS/
8174T- 4	H*	20	10.000	A16IDPXO/HSTAR/H.DMS/
8174T- 5	H*	20	10.500	A16IDPXO/HSTAR/H.DMS/
8174T- 5	PL	9	4.500	A16IDPXO/LINK/PLUSLIB/
8174T- 6	H*	20	10.000	A16IDPXO/HSTAR/H.DMS/
8174T- 7	H*	20	10.000	A16IDPXO/HSTAR/H.DMS/
8174T- 8	H*	20	10.000	A16IDPXO/HSTAR/H.DMS/
8174T- 9	H*	20	10.000	A16IDPXO/HSTAR/H.DMS/
8174T- 9	PL	9	4.500	A16IDPXO/LINK/PLUSLIB/
8174T-10	H*	20	10.000	A16IDPXO/HSTAR/H.MSFMAC/
8174T-10	PL	9	4.500	A16IDPXO/LINK/PLUSLIB/
8174T-11	H*	18	9.000	A16IDPXO/HSTAR/H.MSFMOD/
TEST1- 0	20	6	6.000	B29IDPXO/OBJECT/CAM/
TEST1- 0	30	6	6.000	B29IDPXO/OBJECT/GRT/
TEST1- 0	10	6	6.000	B29IDPXO/OBJECT/MUM/
TEST1- 2	20	13	6.500	B29IDPXO/OBJECT/CAM/
TEST1- 2	30	13	6.500	B29IDPXO/OBJECT/GRT/
TEST1- 2	10	13	6.500	B29IDPXO/OBJECT/MUM/
TSS - 0		13	13.000	A16IDPXO/DATA/TESTDATA/CKPTBAD/
TSS - 0		14	3.500	A16IDPXO/DATA/TESTDATA/DECELCMD/
TSS - 0		7	7.000	A16IDPXO/JOBS/CKPT/
TSS - 0		9	9.000	A16IDPXO/JOBS/DCAPS-EX
TSS - 0		8	8.000	A16IDPXO/RUNJCL/R.CANAL2/
TSS - 0		8	8.000	A16IDPXO/RUNJCL/R.FLASH/
TSS - 0		8	8.000	A16IDPXO/RUNJCL/R.STF/
TSS - 0		8	8.000	A16IDPXO/SYS-UTIL/KISSBK/
TSS - 0		7	7.000	A16IDPXO/SYS-UTIL/LISTJOBS
TSS - 0		7	3.000	A16IDPXO/SYS-UTIL/LIST-R./
TSS - 0		2	2 000	A16IDPXO/JOBS/DCAPS-EX/
TSS - 0		24	8.000	CMDLIB/LSIT/
TSS - 0		10	5.000	DATAMGT/DSTATF/
TSS - 0		15	5.000	DR8XI332XO/CMDLIB/LSIT/

Figure 7-13. Cat/File String Report

locate the file per MME GEFSYE. It will also provide the file code assigned to the file so that a cross reference can be made to the File Code Summary Report. This report is off by default and must be explicitly requested with the user input option (CAT) (see subsection 7.6.17).

In creating a structure, a user must be aware of the accesses that are required to actually obtain a file. Since the SMC is divided into 32 sections and each section is accessed via a hash, a user name can usually be found with one disk access. This is true if the total number of different user names is no more than 300 and all userids are evenly distributed over the 32 sections. It should also be noted that SMC contention (FMS attempting to access more than one SMC entry in the same section at the same time) can be significantly reduced by an even distribution of user names across the 32 sections.

The UMC is arranged so that access to the file description for one of the first four files or catalogs cataloged for a user requires one disk access, to one of the first 18 files requires one or two disk accesses, to one of the first 37 requires one, two or three accesses and so on.

If a large number of files are cataloged under the same user, allocation of the most of these files will be slow, since locating their file descriptions requires many disk accesses. For example, if there are 1000 files cataloged under a single user, allocating any one of the 500 files listed last requires between 28 and 54 disk accesses.

When it is necessary to include a large number of files under one user name, using subordinate catalogs each to include a fraction of the total can reduce the number of disk accesses.

Most the connects being displayed by this report are not attributed to the particular job in the File Code Summary Report. Rather the large portion of these connects are attributed to the Peripheral Allocator, file (*,), since it is the Peripheral Allocator that is responsible for issuing the MME GEFSYEs required to locate a given user file.

In figure 7-13, we see that job 8174T, activity 0, has three references to file code H*, where each H* is to a different Cat/File string. The reason for this is that during allocation (activity 0) the peripheral allocator must insure that all files referenced in the entire job are available to be used by this job. For job 8174T file H.DMS is asigned to H* in activities 3, 4, 5, 6, 7, 8 and 9, while file H.MSFMAC is assigned to H* in activity 10 and file H.MSFMOD is assigned to H* in activity 11. Therefore, since three different files are assigned to file code H* during the course of the job, activity 0 of that job will display three different references to file code H*. The reader will notice that file H.DMS is actually used in activities 3, 4, 5, 6, 7, 8 and 9, and that during activity 0 the peripheral allocator actually searched for this file 7 times for a total of

70 connects, or 10 connects per search. Then during the activity in which it was actually used, an additional two catalog searches (20 connects) were also required.

7.5.14 Connect Summary Report By Userid/SNUMB (File 23). If the user does not want to produce a complete File Code Summary Report, he may request that a report be produced for only certain USERIDs and/or SNUMBS. In this case, a much smaller File Code Summary Report (subsection 7.5.12) report will be produced. In addition, the user will receive a Connect Summary Report which will indicate, for the requested items, the number of times that USERID or SNUMB was referenced, the total number of connects made by that individual and the % of total connects represented by that item. If a requested SNUMB has a USERID equal to a requested USERID, then it will be reported twice in this report. See figure 7-14 for a sample of this report. This report is not produced by default and must be requested by a user input option (PROJ) (subsection 7.6.11).

7.5.15 Activity Summary Report (File 24). The Activity Summary Report lists each activity processed during the monitoring period and summarizes the activities as characterized by the five variables: CP Time, Mass Storage Connects, Total Connects, and CP Time Per Connect (Mass Storage/Total) (see figure 7-15). The report lists the SNUMB-ACTIVITY number, the CP TIME (in milliseconds) charged by accounting to the job during the monitoring period, the number of connects issued to Mass Storage, the number of connects issued to Mass Storage and Tape, and the ratio of CP time over accesses for both Mass Storage Accesses and Mass Storage and Tape Accesses in the column headed CP TIME PER CONNECT. The bottom line of this report is titled TOTALS and gives the total charged processor time, the total connects, and the ratio of these totals.

The mass storage connects are displayed along with the total connects. For example, $PALC issued 167 mass storage connects and 411 total connects. This represents 13,241.93 milliseconds of CPU time per mass store connect and only 5,380.54 milliseconds of CPU time between any connect type.

A line of asterisks are output when the monitor terminates in order to signify that the jobs that follow did not necessarily terminate. Information known about each job at the monitor termination is output. This report is on by default but may be turned off with a user input option (OFF) (subsection 7.6.9).

The report is useful in two applications. First, a quantitative feel for the CPU I/O balance of the system operation may be obtained from the TOTALS ratio of CP TIME PER CONNECT. Secondly, particular jobs which use excessive amounts of CPU or I/O time may be identified by SNUMB by scanning the list. More details on file usage of each activity in the Activity Summary Report are given on the File Code Summary Report. The $IDENT card of the job can also be found there for a more complete job identification.

CONNECT SUMMARY REPORT BY USERID/SNUMB FOR SYSTEM NMCC2 ON 81-09-20

USERID/SNUMB	# OF ACTIVITIES	# OF CONNECTS	% OF TOTAL CONNECTS
DJ8XI70202	0	0	0.
DJ8XI70203	3	587	1.106
OPNSUTIL	1	3	0.006
DMSTA	1	2088	3.932
NEWRM	0	0	0.
8174T	11	7352	13.846
TSS	1	1891	3.561
$PALC	1	2224	4.188

Figure 7-14. Connect Summary Report By USERID/SNUMB

ACTIVITY SUMMARY REPORT FOR SYSTEM NMCC ON 81-12-01

SNUMB	CP TIME(MS)	CONNECTS MASS	TOTAL	CP TIME PER CONNECT
6018T-1	248	30/	40	6.53/ 6.20
SYSCH-0	1271	139/	139	9.14/ 9.14
6862T-1	1335	203/	203	6.58/ 6.58
6861T-1	2510	220/	241	11.41/ 10.41
6864T-1	516	66/	67	7.82/ 7.70
6852T-1	9838	617/	517	19.03/ 19.03
6847T-2	11646	659/	659	17.98/ 17.98
		*************************		
$CALC-0	2490	101/	196	13.76/ 12.70
$PALC-1	2211402	167/	411	13241.93/5360.54
$SYOT-0	0	343/	893	0. / 0.
$RTIN-0	43951	102/	102	430.89/ 430.89
TSS -1	25139	2972/	2972	8.46/ 8.46
OMF -2	0	15/	62	0. / 0.
6865T-1	2268	71/	72	31.94/ 31.50
SYSCH-0	404	130/	130	3.11/ 3.11
6056T-1	10893	637/	638	17.10/ 17.07
RESOU-1	0	10/	10	0. / 0.
DMSTA-1	8473	20/	20	423.65/ 423.65
HEALS-1	7946	8/	8	1324.33/1324.33
6845T-1	13614	714/	714	19.07/ 19.07
6769T-1	444244	1019/	1019	435.96/ 435.96
6866T-1	6292	295/	296	21.22/ 21.26
6852T-2	1260	79/	79	15.95/ 15.95
SYSCH-0	2370	419/	419	5.66/ 5.66
6861T-2	799	95/	95	8.41/ 8.41
TOTALS	179782976	94650	100000	1899.45 1797.830

Figure 7-15. Activity Summary Report

This report will display all connects issued by a job with no regard to the type of I/O command or the validity of the seek address (see subsection 7.3).

7.5.16 Device Area File Code Reference Report (File 22). This report is generated to provide details on the jobs accessing a specific device area with their file codes. Figure 7-16 displays an example. The devices and areas to be listed are defined by the user when requesting input option Area (subsection 7.6.1). In figure 7-16, there are 10 areas requested for investigation. Each activity that accessed a device area is displayed in the report. At the end of the report, the number of connects found to each requested area is also given. This report is identical in format to the File Code Summary Report (subsection 7.5.12) except that this report contains only the file codes which referenced the specific area of the desired devices. The AREA N of each file code specifies within which area of the possible set of requested areas this particular file code fell. When this option is selected, the file code reference will automatically be expanded and special system file codes will be reported only if they actually referenced the requested area (see subsection 7.5.12). In addition, if the special system file codes referenced multiple areas, these file codes will appear multiple times within this report. In figure 7-16, it can be seen that activity 3 of job 52323 has multiple references to file code 0%. In the standard File Code Summary Report, all these references would have been grouped as a single reference, but in this report, they are expanded within each unique area requested by the user.

A complete explanation of the special file codes can be found in subsection 7.5.12. This report is not produced under default conditions and must be requested with a special user input option (AREA) (subsection 7.6.1).

7.5.17 Device File Use Summary Report (File 21). This report shows the device use by the accesses per file class (temporary or permanent). Figure 7-17 is an example of this report. Each of these classes of allocation is subdivided into sequential and random files and their corresponding percentage of the total file use is presented in the report. File 00 accesses are not included in this report. This report will reflect only multicommand connects, but will make no check as to the validity of the seek address (see subsection 7.3). The device numbers being reported under the "DEVICE" column are the unique set of device numbers generated by the MSMDRP (see subsection 7.5.5). This report is on by default but may be turned off with a user input option (OFF) (subsection 7.6.9).

7.5.18 Chronological Device Utilization Report (File 26). This report provides a chronological listing of the six most active disk devices, by device number and their probability of utilization (see figure 7-18). This report is so designed that any time quantum can be set in the report. By varying the time quantum parameter, the user may select integer values from 1 to n (where n is a positive value in seconds). A time quantum variation is requested with a user input option (TIMEQ) (subsection 7.6.14).

DEVICE AREA FILE CODE REFERENCE FOR SYSTEM NMCC ON 81-21-01

```
SNUMB,ACTVY #,IDENT,USERID  52323- 3    1820011/10/4887/                                      498IDPOJ
-------------------------------------             FILE  SIZE        ALLOCATED      FILE ORIGIN
        FILE CODE      CONNECTS              (LLINK/CYLINDER)      DEVICE      (LLINK/CYLINDER)
          0% P R N F      19                      0/  0            1-14-11        162/  1     AREA 4
          0% P R N F       8                      0/  0            0-12-11       1052/  6     AREA 4

SNUMB,ACTVY #,IDENT,USERID  7862T- 1    1833333/10,WOANFF                                     498IDPOJ
-------------------------------------             FILE  SIZE        ALLOCATED      FILE ORIGIN
        FILE CODE      CONNECTS              (LLINK/CYLINDER)      DEVICE      (LLINK/CYLINDER)
          0% P R N F       2                      0/  0            0-12-11         92/  0     AREA 4
          0% P R C F     706                  16384/108            0-12-11       3446/ 22     AREA 8

SNUMB,ACTVY #,IDENT,USERID  52323- 4    1820011/10/4887                                       498IDPOJ
-------------------------------------             FILE  SIZE        ALLOCATED      FILE ORIGIN
        FILE CODE      CONNECTS              (LLINK/CYLINDER)      DEVICE      (LLINK/CYLINDER)
          0% P R N F      10                      0/  0            0-12-11       1153/  7     AREA 4

NUMBER OF CONNECTS PER AREA
    1888      10        325       2766      844       1368      1368    706      0       4723
```

Figure 7-16. Device Area File Code Reference Report

MSM DEVICE FILE USE SUMMARY REPORT FOR SYSTEM NMCC ON 81-12-01

	TEMPORARY ALLOCATION (32%) ACCESSES					PERMANENT ALLOCATION (67%) CATALOGED ACCESSES (27%)					PERMANENT ALLOCATION (67%) NON-CATALOGED ACCESSES (40%)				
DEVICE	SEQUENTIAL	%	RANDOM	%	TOTAL	SEQUENTIAL	%	RANDOM	%	TOTAL	SEQUENTIAL	%	RANDOM	%	TOTAL
1	389	5	6800	94	7189	19	2	618	97	637	0	0	21406	100	21406
2	192	3	5856	96	6048	80	100	0	0	80	0	0	5134	100	5134
3	0	0	0	0	0	0	0	0	0	0	0	0	230	100	230
4	78	44	96	55	174	0	0	274	100	274	0	0	567	100	567
5	8541	59	5842	40	14383	8	3	237	96	245	0	0	1026	100	1026
6	917	89	102	10	1019	20	5	333	94	353	0	0	199	100	199
7	0	0	5295	100	5295	1	10	9	90	10	0	0	447	100	447
8	0	0	6075	100	6075	25	32	53	67	78	0	0	224	100	224
9	0	0	851	100	851	28	1	1676	98	1704	0	0	231	100	231
10	960	86	156	13	1116	13	10	111	89	124	0	0	4215	100	4215

Figure 17. Device File Use Summary Report

CHRONOLOGICAL REPORT OF DEVICE UTILIZATION FOR SYSTEM OSCC2 ON 79-10-25

TIME	DEVID	PROB	DEVID	PROB	DEVID	PROB	DEVID	PROB	DEVID	PROB	DEVID	PROB
11:35:38:10	4	0.36	2	0.24	8	0.12	11	0.08	15	0.08	16	0.08
11:36:38:00	4	0.44	19	0.24	2	0.09	16	0.06	8	0.05	11	0.05
11:37:38:00	4	0.32	20	0.17	16	0.09	2	0.07	11	0.06	12	0.05
11:38:38:00	21	0.49	4	0.07	1	0.07	15	0.07	14	0.04	9	0.04
11:39:38:00	21	0.55	4	0.07	14	0.05	9	0.04	16	0.04	15	0.03
11:40:38:00	21	0.60	4	0.10	1	0.05	2	0.05	14	0.03	8	0.02
11:41:38:00	21	0.73	4	0.09	2	0.06	1	0.03	11	0.01	8	0.01
11:42:38:00	21	0.68	4	0.09	2	0.05	1	0.03	11	0.02	14	0.02
11:43:38:00	21	0.72	4	0.11	2	0.05	8	0.02	1	0.02	14	0.01
11:44:38:00	4	0.21	21	0.21	1	0.13	7	0.11	8	0.07	2	0.06
11:45:38:00	4	0.21	15	0.18	21	0.15	7	0.07	1	0.07	2	0.05
11:46:38:00	21	0.30	4	0.21	8	0.18	1	0.10	14	0.04	16	0.03
11:47:38:00	21	0.26	4	0.23	1	0.15	8	0.08	10	0.04	2	0.03
11:48:38:00	4	0.21	17	0.18	21	0.12	1	0.09	8	0.06	9	0.06

Figure 7-18. Chronological Device Utilization Report

The default time parameter is set for 60 seconds and prints the 6 most active disk devices over each minute of monitoring time. The first column shows the time, starting at the beginning and terminating at the ending time of the tape or timeframe. The remaining columns show six disk devices, by device number with their probability of utilization, consecutively, in descending order, relative to the activeness of all the disk devices. The utilization is the probability of that device being accessed over the time quantum. By examining figure 7-18, one can see that device 4 is the most active disk device with device 21 being a very close second. The device numbers being reported under the "DEVID" column are the unique set of device numbers generated by the MSMDRP (see subsection 7.5.5). This report is not produced by default and must be requested with an input option (ON) (subsection 7.6.10).

7.5.19 FMS Cache Report (File 21). If the system being monitored is configured with FMS cache, the report shown in figure 7-19 will always be generated and cannot be turned off. At the current time, the actual meaning and importance of the various data items are not known. The data items are internal counters generated by GCOS in its own monitoring of FMS Cache operation. A study is currently underway to get a full definition of each of the reported values, and when the study is completed, and update to this section will be written.

7.5.20 Proportionate Device Utilization Report (File 42). This report shows the proportionate utilization of each device configured on the mass storage subsystem. Figure 7-20 is an example. This histogram identifies each unique device ID (device number zero is an MPC controller) and provides both a count of the number of accesses made to each device (under the column headed INDIV. NUMBER) as well as the percent of all accesses which were to each device (under the column headed INDIV. PRC). The histogram shows the proportionate utilization of each device (i.e., the percent of all accesses which went to each device) in a graphical form. The physical device that each "Device ID" of the histogram represents is shown in the Physical Device ID Correlation Table (see figure 7-5). This report is always generated and cannot be turned off. In this report the user is looking for a device or devices which have significantly more utilization than others in the system. This highly used device would then be a potential bottleneck.

It is desirable, but not always practical, to have equal utilization for each device. The user should be reminded that data in figure 7-20 is cumulative over the monitoring period. The actual accessing pattern could have been periodic with the following form: Many accesses to device 4 followed by many accesses to device 3 followed by many accesses to device 2 followed by many accesses to device 1, etc. Each device could have been a bottleneck for a subperiod of the total monitoring period. This could also have been the case if the proportionate utilization of each device was equal. The Channel Monitor can be used to uncover this cyclic type of

FMS CACHE REPORT FOR SYSTEM NMCC ON 81-12-01

CACHE HITS	WRITES	READS	NON CC READS	NON 320 READS	SSTAK SKIPS	CACHE CLEARS	NO HITS	HITS
11182	8379	24786	550	20	223	3867	148	2

Figure 7-19. FMS Cache Report

```
                   DISTRIBUTION COLLECTED ON SYSTEM OSCC2 AT 13:49:04 ON 81-09-28

                              DEVICE UTILIZATION BY DEVICE NUMBER

INDIV.    CUMUL.    CUMUL.    INDIV.   DEVICE              PERCENT OF OCCURRENCE                    REPORT
NUMBER    NUMBER     PRC       PRC      ID       00   05   10   15   20   25   30   35   40   45   50      1
                                                 I....I....I....I....I....I....I....I....I....I....I
    12        12    0.000     0.000     0-  0    I
 18947     18959    9.835     9.828     1-  1    Ixxxxxxxxxx
  8206     27165   14.091     4.257     2-  2    Ixxxx
 20269     47434   24.606    10.514     3-  3    Ixxxxxxxxxxx
 34033     81467   42.260    17.654     4-  4    Ixxxxxxxxxxxxxxxxxx
   238     81705   42.384     0.124     5-  5    I
 25580    107285   55.653    13.269     6-  6    Ixxxxxxxxxxxxx
   .         .        .         .       .   .    .
   .         .        .         .       .   .    .
   .         .        .         .       .   .    .

192774 ENTRIES                 0 OUT OF RANGE
```

Figure 7-20. Proportionate Device Utilization Report

usage. In addition, the Chronological Device Utilization Report (see subsection 7.5.18) was designed to uncover this type of problem by breaking down device utilization over time, rather than by utilizing a histogram. Nevertheless, when a single or small number of devices has a disproportionately large share of the accesses, they are potential bottlenecks and their usage should be further analyzed.

This report will show all connects that were issued to a given device. This includes all read/write connects, as well as any command type connects issued to a given device.(See subsection 7.3).

7.5.21 Elapsed Time Between Seeks Report (File 42). This is a histogram report for the frequency of occurrence of elapsed time intervals between the issuance of mass storage access connects. Figure 7-21 presents a sample. The elapsed time is calculated as the time difference between successive mass storage connects from the central system and thus is representative of the workload. It does not provide any meaningful information on the subsystem service capabilities.

The data presented give the count (INDIV. NUMBER) and percentage (INDIV. PRC) of elapsed time between accesses which fell within each time range. The column headed TIME MSECS gives the time range in milliseconds. Thus, the data of the row with a time of 18 gives the count and fraction of elapsed time intervals in the range of 17+ to 18 milliseconds. The columns headed CUMUL. NUMBER and CUMUL. PRC. give the accumulated counts and percentage and are useful in describing the mass storage rates, e.g., 75.4 percent of the accesses occur less than 21 ms after the last access.

The bottom of the report provides a statistical summary of the data in the report. Statistics given include average, variance, and standard deviation. These statistics apply to all data points that were measured. The statistics concerning OUT OF RANGE are for those data points which fall outside the range of the histogram. OUT OF RANGE points are included in the previous statistics. This report is always generated and cannot be turned off.

7.5.22 Data Transfer Size Report (File 42). A sample histogram report on the frequency of occurrence of sizes of the data blocks transferred between mass storage and main memory is given in figure 7-22. Refer to subsection 7.5.12 for a description of the histogram format. This report has increments of 64 words, and the number in the column headed NUMBER WORDS is the upper value. The occurrence of certain data transfer sizes should be anticipated. For example, 64-word blocks are used for catalog accessing; in other parts of GCOS, standard system format is 320 words. SSA modules are usually slightly less than 512 words. Special user application data base structures may use a different but observable block size, and this report will give an indication of the relative frequency of reference to that data base. It should be noted that this data is derived by the

DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 18:36:38 ON 81-03-13

ELAPSED TIME BETWEEN SEEKS

INDIV. NUMBER	CUMUL. NUMBER	CUMUL. PRC	INDIV. PRC	TIME MSECS		PERCENT OF OCCURRENCE 00 05 10 15 20 25 30 35 40 45 50 I....I....I....I....I....I....I....I....I....I....I	REPORT 2
0	0	0.	0.	0-	0	I	
5935	5935	2.066	2.066	1-	1	Ixx	
7879	13814	4.809	2.743	2-	2	Ixxx	
10424	24238	8.438	3.629	3-	3	Ixxxx	
13957	38195	13.297	4.859	4-	4	Ixxxxx	
13675	51870	18.058	4.761	5-	5	Ixxxxx	
14260	66130	23.023	4.965	6-	6	Ixxxxx	
14658	80788	28.126	5.103	7-	7	Ixxxxx	
13735	94523	32.908	4.782	8-	8	Ixxxxx	
13192	107715	37.500	4.593	9-	9	Ixxxxx	
12161	119876	41.734	4.234	10-	10	Ixxxx	
11550	131426	45.755	4.021	11-	11	Ixxxx	
10956	142382	49.569	3.814	12-	12	Ixxxx	
10396	152778	53.189	3.619	13-	13	Ixxxx	
9580	162358	56.524	3.335	14-	14	Ixxx	
9380	171738	59.789	3.266	15-	15	Ixxx	
8894	180632	62.886	3.094	16-	16	Ixxx	
8319	188951	65.782	2.896	17-	17	Ixxx	
7945	196896	68.548	2.766	18-	18	Ixxx	
7182	204078	71.048	2.500	19-	19	Ixxx	
6454	210532	73.295	2.247	20-	20	Ixx	
.	.	.	.	.	.	.	
.	.	.	.	.	.	.	
.	.	.	.	.	.	.	
567	278696	97.026	0.197	49-	49	I	

287238 ENTRIES TOTAL AVERAGE = 16.89080 VARIANCE = 35200.476 STANDARD DEVIATION = 187.618

Figure 7-21. Elapsed Time Between Seeks Report

```
                    DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 18:36:38 ON 81-03-13

                                      DATA TRANSFER SIZE

 INDIV.   CUMUL.   CUMUL.   INDIV.   NUMBER              PERCENT OF OCCURRENCE                  REPORT
 NUMBER   NUMBER    PRC      PRC      WORDS    00  10  20  30  40  50  60  70  80  90  100       3
                                               I....I....I....I....I....I....I....I....I....I....I
  10195    10195    3.493    3.493     0-  63  Ixx
  13634    23829    8.163    4.671    64- 127  Ixx
   1994    25823    8.846    0.683   128- 191  I
   2392    28215    9.666    0.819   192- 255  I
  15622    43837   15.018    5.352   256- 319  Ixxx
 173872   217709   74.583   59.565   320- 383  Ixxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
  12159   229868   78.748    4.165   384- 447  Ixx
  15620   245488   84.009    5.351   448- 511  Ixxx
  10051   255539   87.543    3.443   512- 575  Ixx
    129   255668   87.587    0.044   576- 639  I
   8206   263874   90.398    2.811   640- 703  Ix
     80   263954   90.426    0.027   704- 767  I
     35   263989   90.438    0.012   768- 831  I
      .        .        .        .     .    .  .
      .        .        .        .     .    .  .
      .        .        .        .     .    .  .
     29   283963   97.280    0.010   3136-3199 I

 291902 ENTRIES TOTAL   AVERAGE =  710.98554   VARIANCE =  6275221.500   STANDARD DEVIATION =  2505.039
```

Figure 7-22. Data Transfer Size Report

monitor from a scan of the DCW list at connect time. Any I/O which uses an "embedded DCW" list technique, or includes a transfer DCW in the list, may not have its size correctly recorded by the monitor. The size recorded will be less than the actual size for these special cases. This report is always generated and cannot be turned off.

7.5.23 Number of DCWs per Connect Report (File 42). The distribution length of the DCW list per connect is displayed in figure 7-23. Refer to subsection 7.5.12 for a description of the histogram format. As mentioned in subsection 7.5.22, an "embedded DCW" or TDCW may record a shorter than actual length. This report is always generated and cannot be turned off.

7.5.24 Connects Per Minute Report (File 20). This report (figure 7-24) provides a time-oriented summary of the number of connects issued by all jobs executing in the system, by the TimeSharing Subsystem, and by specially defined user jobs.

This report would be useful in a study of Time Sharing Response. If Time Sharing Response was known to be bad during a given time period, this report would provide some indication as to whether or not the rate of I/O was excessive during that period. This report is off by default and must be turned on with a user input option (ON) (subsection 7.6.10). The time quantum control has a default value of 10 minutes but can be varied by a user input option (RATECH) (subsection 7.6.16). If specially defined user jobs are to be reported, the user input option RATE must be invoked (subsection 7.6.18).

7.5.25 Special Processing Messages. During the course of processing, several special processing messages may be generated by the MSMDRP. Most of these are for information purposes only and can be ignored by the analyst. Following is a list and brief explanation of the most common messages. These messages will most normally occur immediately in front of the System Configuration and Channel Usage Report.

- MONITOR MUM WAS ACTIVE . . . .
  This message is produced for each monitor that was active during the monitoring session.

- MSM DATA REDUCED FROM CHANNEL MONITOR . . .
  The MSM was not active during the monitoring session but the Channel Monitor was active. Sufficient information is collected so that all reports from the MSMDRP can be generated with the exception of the SSA cache portion of the Individual Monitor Activity Report (see subsection 7.5.10).

- RUN BEING TERMINATED. DATA FOR MONITOR . . .
  Neither the MSM or CM were active and, therefore, no reports can be produced.

- PROCESSOR # N IS (AVAILABLE/RELEASED) AT (TIME)
  This message will indicate the assignment or releasing of

```
                    DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 18:36:38 ON 81-03-13

                                   NUMBER OF DCWS PER CONNECT

 INDIV.    CUMUL.    CUMUL.    INDIV.   NUMBER                PERCENT OF OCCURRENCE                REPORT
 NUMBER    NUMBER     PRC       PRC      DCWS    00   10   20   30   40   50   60   70   80   90  100    4
                                                 I....I....I....I....I....I....I....I....I....I....I
      0         0    0.        0.        1-  0   I
 237522    237522   81.370    81.370     1-  1   Ixxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
  22516    260038   89.084     7.714     2-  2   Ixxxx
   3060    263098   90.132     1.048     3-  3   Ix
  22123    285221   97.711     7.579     4-  4   Ixxxx
    257    285478   97.799    0.088      5-  5   I
    290    285768   97.899    0.099      6-  6   I
    .         .        .         .       .   .   .
    .         .        .         .       .   .   .
    .         .        .         .       .   .   .
    357    291875   99.991     0.122    37- 37   I

 291902 ENTRIES TOTAL      AVERAGE =    1.79091     VARIANCE =   12.407     STANDARD DEVIATION =   3.522
     27( 0%) OUT OF RANGE  AVERAGE FOR THESE =      40.00  IN RANGE AVERAGE =    1.79
```

Figure 7-23. Number of DCWs Per Connect Report

MSM CONNECTS PER   5 MINUTE REPORT FOR SYSTEM DNAH66 ON 81-12-17

TOD	2783T	TS1	TOTAL
10:10:00.00	4641	1160	17988
10:15:00.00	12168	1565	15590
10:20:00.00	11492	1126	25680
10:25:00.00	9766	1451	20420
10:30:04.50	5132	758	10550

Figure 7-24. Connect Per 5 Minute Report

processors and provides the processor number involved as well as the time of day the assignment/releasing of processors occurred.

- FOLLOWING PRINTS ARE THE INPUT OPTIONS . . .
  An echo print of all nonstandard input options selected will be produced. If any input option is described incorrectly, an error message will be generated indicating the type of error and the card number in error. The user should correct the error and resubmit the job for processing.

- FOR INFORMATION ONLY
  This message will then be followed by several lines of output describing special record types that have been processed, or special processing events that have been executed by the MSMDRP. In most cases, the message can be ignored. Those messages which are important, and reveal an error in processing logic, will be described below. All other messages will not be described.

- JULIAN DATES ARE BAD - RUN TERMINATED
  Every GMF data record is preceded by the current Julian date. The MSMDRP has found a Julian date that does not agree with the Julian date found on previous records. This can occur when an old GMF data tape is reused without degaussing. Old data is on the tape, and if the new data failed to write an end of file mark on the tape because of a system crash or malfunction, the MSMDRP, after reaching the end of the new data, would attempt to process the old data without realizing that it was old. The check on the Julian date prevents this from happening. The MSMDRP will terminate cleanly and all reports will be produced.

- HAVE INCREASING OR BAD SEQUENCE NUMBERS . . .
  A problem has occurred in reading the data tape. If the run is reprocessed, the error may disappear. If it reoccurs, then the tape was generated with an error. In most cases, the MSMDRP will recover and processing will not be significantly affected. If it occurs often, contact CCTC/C751.

- PROCESSING TERMINATED BY NXTRECRD . . .
  MSMDRP has requested the operator to mount a new tape and the operator responded that he did mount the new tape. However, MSMDRP is unable to match the inital record on the new tape with the last record on the old tape. User should check the data collection procedure to insure that correct tapes were mounted during the data collection phase. MSMDRP will terminate cleanly and all reports will be produced.

- INCURRED A BAD SEEK ADDRESS . . .
  In the logic processing of subroutine SYSTMFIL, an unexpected condition has occurred. MSMDRP will continue processing correctly, but if this occurs frequently, CCTC/C751 would like to be notified. Call 202-695-0856.

7.6 Default Option Alteration

Most users rely upon the standard MSM Report formats and their default values as these suit a wide range of needs. A capability to change the reports is built into MSMDRP. The general form for all option requests are as follows: The first card contains an action code describing the action to be taken. Subsequent cards modify report parameters for some of the action codes. All input cards are free format with the only requirement being that at least one blank space separates multiple input parameters. The very last input card must have the word "END" entered in it. This card must be present whether or not any other input options are selected.

There is no specific order required of the options, and multiple entries of each are permissible. If several inputs refer to the same report, the last one encountered will have precedence. If a report is turned off by default and is modified, it will be turned on through the request for modification. The chart below shows the available actions: the mnemonic code for the user to identify the action; the function; and the default.

Mnemonic	Function	Default (indicated in parentheses)
AREA	Request file code references made to a specific area of a specific device	(not provided)
DEBUG	Debug	(no debug)
ERROR	Do not stop on Input Error	(stop)
FILDEF	Define system files by name	(no names used)
END	This card must be present	
MODULE	Produce the SSA Module Usage Report by Job	(no report produced)
NCONN	Process a limited number of connects	(total tape processed)
NREC	Process a limited number of tape records	(total tape processed)
OFF	Turn reports off	(all reports ON except reports 12,16, 18,20 - see table 7-1)
ON	Turn reports on	(all reports on except reports 12,16, 18,20 - see table 7-1)
PROJ	Produce the Connect Summary Report by Userid/SNUMB	(no report produced)

RN	This option must be selected when .MSMDRP is used to process WW6.4 data or when MSMDRP is executed on a WW6.4 system	(process WW7.2/4JS data on a WW7.2/4JS system)
TIME	Set a timespan for measurement	(no time criterion)
TIMEQ	Change time quantum for Chronological Device Utilization Report	(report is off - default value is 60 seconds)
USERID	Suppress userids from reports	(userids printed)
RATECH	Change time quantum for Connects Per 10 Minute Report	(report is off - default value is 10 minutes)
CAT	Turn on the Cat/File String Report	(report off)
RATE	Request the Connect Per 10 Minute Report for specific user jobs.	

7.6.1 Monitor a Specific Device Area (Action Code AREA). This option allows a user to specify specific areas of a device for which all jobs referencing this area are to be highlighted. The format of the display is that of a File Code Summary and contains those jobs and file codes that reference the area of interest.

The device to be investigated is identified via the PUB and IOM number. The specific areas of interest are identified as beginning at the starting address defined in llinks. The length of the area is also in llinks, with a zero meaning the end of the device. A total of ten possible areas are allowed. The format for this card is shown in figure 7-25.

See subsections 7.5.12 and 7.5.16 for complete details on the report format generated with this user option. This report is off by default and will be activated by the processing of this action code.

7.6.2 System Debug (Action Code DEBUG). This is a restricted option for GMF system developers. DEBUG should only be used with guidance received by CCTC/C751.

7.6.3 Continue Data Reduction After an Input Option Error (Action Code ERROR). This option allows data reduction to continue when an error has been detected and reported in an input option request. The default value reports the error and aborts the data reduction procedures. The format for this option is the word ERROR on the data card.

7.6.4 Specify System File Names (Action Code FILDEF). This option allows the user to specify the name of each system file displayed in the

Card 1 = A
Card 2 = N
Card 3 = B C D E F

Where

A = The word AREA
N = The number of areas to be specified. A maximum of ten areas are permitted. A Card #3 must be present for each area requestred.
B = IOM number
C = Pub number
D = Device number
E = Starting address in llinks
F = Length of area in llinks

The following definitions apply to this option.

Device Type	Numbers Cylinders	Number Sectors/ Cylinder	Number Sectors/ Block (LLINK)
180	200	360	5
181	200	360	5
190	407	589	5
191	407	760	5
450	811	760	5

Figure 7-25. Specific Device Area Report Card Input

System File Use Summary Report discussed in subsection 7.5.9. This option is specified with a set of data cards. The first data card contains the word FILDEF. The second data card contains the number of system files to be described on the following cards. The following cards each contain a single pair of data points separated by at least one blank. The first data point is the system file number and the second data point is the desired system file name.

The standard output of the System File Use Summary Report is to label each system file as System File 1, System File 2, etc., corresponding to GCOS-HI-USE, GCOS-LO-USE, etc. In order to know the correct order of the file names, the user should check the $ FILES section of the startup deck. The order of the files in the $ FILES section of the startup deck is the order they are referenced in the report.

7.6.5 End Card (Action Code END). This card must be present at all times and must be the last data card supplied. It consists of the word END entered on the card.

7.6.6 Produce the SSA Module Usage Report by Job (Action Code MODULE). This option allows the user to produce the SSA Module Usage Report. This report will list every SSA module used by every job that was run during the monitoring session. See subsection 7.5.11 for details concerning this report. This report is off by default and cannot be turned on by using the ON option. This report can be activated only by entering MODULE on the data card.

7.6.7 Record Limitation by Connects (Action Code NCONN). This option allows a user to process only a specific number of connects. This option is especially useful if the tape contains an error on it and cannot be completely processed. Using this option, the user can process the tape or tapes up to the point where the tape error exists. This option requires two data cards. The first data card contains the word NCONN with the second card containing the number of connects to be processed.

7.6.8 Record Limitation by Records (Action Code NREC). This option allows a user to process only a specific number of tape records. This option is especially useful if the tape contains an error on it and cannot be completely processed. Using this option, the user can process the tape or tapes up to the point where the tape error exists. This option requires two data cards. The first data card contains the word NREC with the second card containing the number of tape records to be processed.

7.6.9 Turn a Report Off (Action Code OFF). This option allows a user to turn a report off that is on by default. In MSMDRP, all reports are on except report numbers 12, 16, 18 and 20 (see table 7-1). Only those reports in table 7-1 that have the "NAME=" designation can be turned off with this option. Two data cards are required to use this option. The first card contains the word OFF and the second card contains the name of the report as displayed in table 7-1 with the "NAME=" designation.

7.6.10 Turn a Report On (Action Code ON). This option allows a user to turn a report off that is on by default. In MSMDRP, all reports are on except report numbers 12, 16, 18 and 20 (see table 7-1). Only those reports in table 7-1 that have the "NAME=" designation can be turned on with this option. Two data cards are required to use this option. The first card contains the word ON and the second card contains the name of the report as displayed in table 7-1 with the "NAME=" designation.

7.6.11 Produce Connect Summary Report by Userid/SNUMB (Action Code PROJ). This option allows the user to specify up to a total of 40 USERIDs and SNUMBs for which he wants the Connect Summary Report by Userid/SNUMB produced. The number of SNUMBs requested cannot exceed 10. In addition, since the File Code Summary Report can result in a large amount of output, the user may want to see the File Code Summary Report only for a prespecified set of jobs or USERIDs. For example, the user can request 35 different USERIDs and 5 SNUMBs or 40 different USERIDs and 0 SNUMBs or 30 different USERIDs and 10 SNUMBs or 3 different USERIDs and 6 SNUMBs, etc. The format for this option is shown in figure 7-26. If values of zero are desired, they must be punched on the card. A blank is not equivalent to a zero. In addition to producing a limited File Code Summary Report, a Connect Summary Report is also produced. This summary report will indicate for each requested USERID or SNUMB the number of connects made by the job or USERID. If a requested SNUMB also has a requested USERID, the number of connects issued by that job will be reported twice in the summary report. Refer to subsection 7.5.14 for a description of the report to be produced with this option.

7.6.12 Reduce WW6.4 Data or Process MSMDRP on a WW6.4 System (Action Code RN). This option requires two cards. The first card has the letters RN and the second card one of the following numbers:

1 - WW6.4/2H system processing WW6.4/2H data
2 - WW6.4/2H system processing WW7.2/4JS data
3 - WW7.2/4JS system processing WW6.4/2H data

The default is a WW7.2/4JS system with WW7.2/4JS data.

7.6.13 Set a Timespan of Measurement (Action Code TIME). The timespan of data collection can cover many hours of which only a few may be of interest. This option allows a user to specify the timespan (or spans) to displayed in all reports. For example, the user may specify that he wants to collect data from 0500 to 2200 and wants to display data only from 0900 to 1700 in all reports.

If the entire reduction will have a set timespan, the name "TOTAL" is used. Histogram reports cannot be individually timespanned. All timespans of "other" reports will be bounded by the overall report timespan, if one will be used. Up to five timespans for each report type may be specified,

Card 1 = A
Card 2 = B C D
Card 3+ = E
Card 4+ = F

Where

A = The word PROJ
B = 1 if Connect Summary Report is desired and a complete File Code Summary Report is wanted
= 2 if Connect Summary Report is desired and only a partial File Code Summary Report is wanted
C = Number of Userids (30 MAX)
D = Number of SNUMBS (10 MAX)
E = A total of C Userids with one Userid per card
F = A total of D SNUMBS separated by at least one blank space. All SNUMBS should fit on one card.

Figure 7-26. Limited File Code Summary Input Card Format

and they must be serially ordered. Names for other reports may be found in table 7-1. Only those reports in table 7-1 that have the NAME=specification can be time controlled. If a report does not have this specification, it cannot be time controlled. If the entire reduction is to be time spanned, the name that should be entered on the data card is TOTAL. The format for this action is given in figure 7-27. All times are expressed as four character fields with no intervening blanks. Time is based on a 24-hour clock. If the user wants to request the time 4:07 he must input a "0407".

If a start time but no stop time is desired, no characters should be entered after the minutes of the start time. If stop time is requested, there must be a start time corresponding to it.

The File Code Summary Report, the Activity Summary Report and the Device Area File Code Reference Report are all considered as a single unit under this option. Whenever a time frame is reached for any of these reports, all reports will be spanned. As an example, suppose that the user requested the following:

- File Code Summary Report for 1500-1600 and 1700-1800.
- Device Area File Code Reference Report for 1530-1730.
- Activity Summary Report for 1400-1530

For the above requests, the following report spans would be produced:

- At 1530, the File Code Summary Report would be produced for the period 1500-1530 and the Activity Summary Report would be produced for the period 1400-1530.
- At 1600, the File Code Summary Report would be produced for the period 1530-1600, and the Device Area File Code Reference Report would be produced for the period 1530-1600.
- At 1730, the File Code Summary Report would be produced for the period 1700-1730 and the Device Area File Code Reference Report would be produced for the period 1600-1730.
- Finally, at 1800, the File Code Summary report would be produced for the period 1730-1800.

7.6.14 Change the Time Quantum Value For the Chronological Device Utilization Report (Action Code TIMEQ). The user can change the time quantum value used to produce the Chronological Device Utilization Report by inputting the quantum in seconds. The default value is 60 seconds. Two cards are required. The first card contains the word TIMEQ and the second card contains the new quantum in seconds.

7.6.15 Suppress the USERIDs (Action Code USERID). The user can suppress the printing of USERIDs on the File Code Summary Report by entering the word USERID on a data card.

Card 1 A
Card 2 B
Card 3 C D E F . . .

Where

A = The word TIME
B = Number of different times appearing on Card 3
C,D,E = Time used to define a timespan. Individual times must be separated from each other by at least one blank column. All times are considered to be on a 24-hour clock and must be expressed as a 4-digit field.

Figure 7-27. Input Option TIME Card Format

7.6.16 Change the Time Quantum Value for the Connect Per 10 Minute Report (Action Code RATECH). The user can change the time quantum value used to produce the Connect Per 10 Minute Report by inputting the quantum in seconds. Two cards are required. The first card contains the word RATECH and the second card contains the new quantum in minutes. The default value is 10 minutes.

7.6.17 Turn on the Cat/File String Report (Action Code CAT). This option, consisting of the word CAT on the data card, will turn on the Cat/File String Report (see subsection 7.5.13).

7.6.18 Request the Connect Per 10 Minute Report for Specific User Job (Action Code RATE). This option will allow the user to obtain the Connect Report for specific jobs as well as for the TimeSharing Subsystem and the Total System (see subsection 7.5.24). Card number 1 contains the word RATE, card number 2 the number of jobs desired, and card number 3 the SNUMBs of the jobs desired. In addition to the requested jobs, the TimeSharing Subsystem as well as the Total System will also be reported. If the user wants to obtain this report for only TimeSharing and the Total System, then he simply needs to use the "ON" input option using the name "RATE" for the required report ID.

7.7 JCL

The data reduction procedures consist of a single FORTRAN program having a main level and multiple subroutines.

A description of the more important JCL cards is presented below (see figure 7-28).

The $:LIMITS card should be studied to meet user needs. The run time (99) and output limit (30K) may both need to be altered as required by the duration of the monitoring run. The MSMDRP requires 55K of memory in order to execute plus an additional 2K for SSA space. During the initial loading process, MSMDRP will actually require 68K of memory, but 11K will be released immediately upon loading.

The statement:

```
$    DATA        I*
```

is used to identify the data cards that follow as described in subsection 7.6. At least one data card is required, that being an "END" request.

7.8 Multireel Processing

If more than a single reel of data has been collected, a series of messages will be outputted to the console informing the operator that a new data reel is required. The following are the messages produced.

```
Col 1     8         16
$         IDENT     1820251/30/3044
$         SELECT    B29IDPX0/OBJECT/MSM
$         TAPE      01,X1D,,12345
$         LIMITS    99,55K,-4K,30K
$         DATA      I*
          Data cards - at least an "END" card must be present
$         ENDJOB
```

Figure 7-28. DRP MSM JCL

a. DISMOUNT REEL #XXXXX THEN MOUNT REEL NUMBER YYYYY ON ZZZZZ

In this case, XXXXX is the old reel number, YYYYY is the new reel number, and ZZZZZ is the tape drive ID.

If the operator fails to mount the new tape, the above message will be repeated three times, after which the program will terminate, and all reports produced.

b. IS TAPE XXXXX MOUNTED ON DRIVE ID YYYYY (Y/N)

In this case, XXXXX is the tape number being requested for mounting and YYYYY is the tape drive ID.

This message occurs when the data reduction program finds the wrong tape has been mounted (by comparing internally generated tape labels). If the operator answers N, the message in (c) below is produced. If the operator answers Y, the data reduction program will terminate and all reports will be produced. In this case, the data reduction program is unable to process the tape. Even though the operator is mounting the correct tape, the internal label on the new tape does not match that being requested by the old tape. The user should check the data collection session to insure that the operator did not respond with an incorrect tape number during multireel change.

After entering the Y or N, the operator will need to hit the EOM key twice in order for the response to be transmitted.

c. WRONG REEL JUST MOUNTED, DISMOUNT AND MOUNT REEL XXXXX ON ZZZZZ

In this case, XXXXX is the new reel number, and ZZZZZ is the tape drive ID.

d. CAN TAPE XXXXX BE MOUNTED ON DRIVE YYYYY (Y/N)

In this case, XXXXX is the new desired reel and YYYYY is the tape drive ID.

If the operator fails to answer this message it will be repeated until he responds with a "Y" for YES or "N" for NO. If he types in "Y", then message (a) will be repeated. If the types in "N", then the program will be terminated and all reports will be produced.

7.9 Tape Error Aborts

During the course of processing it is possible that the operator will be required to abort the data reduction program due to an irrecoverable tape error. If such a condition occurs, the operator should abort the job with a "U" abort. This will allow the data reduction program to enter its wrap-up code processing and produce all reports generated prior to the tape error.

SECTION 8. CHANNEL MONITOR DATA REDUCTION PROGRAM (CMDRP)

8.1. Introduction

The Channel Monitor Data Reduction Program (CMDRP) is a FORTRAN program that sequentially processes data the Channel Monitor and Mass Store Monitor collected and wrote on tape. CMDRP produces a number of reports depicting the usage of the mass storage subsystem (i.e., connect time) and the conflicts being caused by multiple accesses to the subsystem. Report descriptions are presented in subsection 8.5.

When making I/O requests, system and user programs are required to provide system software with sufficient information in the request to complete the I/O transaction. In the case of mass store requests, a multiprogram environment will usually generate multiple requests for the same I/O device, causing the I/O system to create a queue for the waiting requests. Since an I/O channel is also a required resource to complete the I/O request, a channel queue may also develop and become a bottleneck in the I/O process. Knowledge of any type of queue in the I/O system is needed to determine if a bottleneck exists and if so, to determine where it is. The Channel Monitor has been developed to collect system events which audit the I/O request process through the I/O system. Associated with the data collection software is an offline reduction program to display the collected data in a meaningful form. Using this information, decisions can be made concerning mass store configuration of channels and devices. In addition, information is also reported concerning the queuing on tape channels. This set of reports, used in conjunction with those provided by the Mass Store Monitor Monitor Data Reduction Program (see section 7), will provide the user with a complete picture of mass store usage. It should be noted that when the Channel Monitor is active, sufficient data is collected to run not only the Channel Monitor Data Reduction Program, but also the Mass Store Monitor Data Reduction Program. However, unless the Mass Store Monitor was active, no reports will be produced on SSA cache performance, FMS catalog cache performance, or Cat/File string structure and accessing (see section 7).

There are two inputs to the CMDRP. The first is the data tape produced by the CM in the General Monitor Collector. The second input is a set of report option control cards used to alter the reports in some way other than the standard default. The various user input options and their formats are described in subsection 8.6. The actual reports produced by CMDRP are described in subsection 8.5.

8.2 Data Collection Methodology

The CM in the General Monitor Collector processes GCOS trace types 4, 7, and 22, which include the following:

- Terminate I/O event

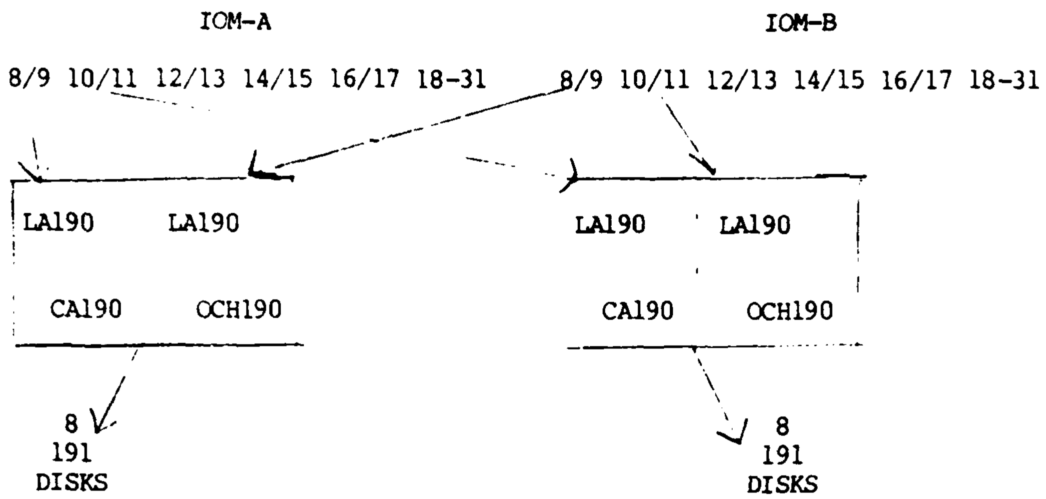


Figure 8-1. IOM Configuration

- o Connect I/O to IOM event
- o Link I/O to I/O chain event

The processing of a type 4 trace records all terminate I/O events generated by Input/Output Supervisor (IOS). The data generated by the processing of this trace event is sufficient to provide the information required by the reduction program for I/O termination processing. The format of the CM generated record for this trace event is described in subsection 5.4.6.1.

The processing of a type 7 trace records all connect events generated by IOS. Additional data are collected by the monitor to be used by both the Channel and Mass Store Reduction programs. These additional data for the Channel Monitor include the I/O queue address located in each monitored program's SSA. The IOM, channel, and device number are also collected for both monitors. The format of the generated record for this trace event is described in subsection 5.4.3.1.

The processing of a type 22 trace records all link I/O queue (i.e., I/O initiation) events generated by IOS. Additional data collected by the CM include the IOM, channel, and device number. The format of the generated record for this trace event is described in subsection 5.4.6.3.

8.3 Analytical Methodology

Three GCOS trace events are used to audit the I/O requests as they are processed through the I/O sequence. These trace types are type 4, type 7, and type 22 which denote the occurrence of a terminate interrupt, I/O connect, and start I/O, in the given order. The collection of these events in the time sequence in which they occur will simulate the I/O entries as they are queued to the various resources of the Mass Store Subsystem. This simulation of the I/O sequence is executed by the data reduction program.

In order to understand the reports produced by the CMDRP, the user should understand the I/O process as performed under GCOS. In the example shown in figure 8-1, channels 8 and 9 of IOM A and B are connected to one set of 8 drives. Channels 10 and 11 of IOM A and B are connected to another set of 8 drives. Each IOM can support up to 24 channels when describing a mass store configuration, and both physical and logical channels can be described. A physical channel is an actual channel over which data may travel. A logical channel is nothing more than a buffer area which is used to set up and store all information required for initiation of the actual I/O event. However, the actual transfer of data cannot be performed until a physical channel is available. However, the establishment of logical channels does allow significant processing to occur prior to the actual transfer of data. Both physical and logical channels require the

use of an IOM port. In figure 8-1, channels 8 and 10 on both IOMs are physical channels while 9 and 11 are logical. Every physical channel may have three other logical channels associated with it; i.e., a total of four channels.

A normal sequence of events produced by a request for I/O would be a type 22, type 7, and type 4 event, in that order. The trace type 22 indicates an I/O request has been issued. The order of the channel numbers, given on the crossbar card of the startup deck, determines the order in which GCOS searches for empty mailboxes and starts I/Os. The first problem area preventing effective I/O throughput will occur if two consecutive logical channel numbers on the same PSIA are sequentially in order on the crossbar card. GCOS, upon receiving an I/O request, will fill the mailboxes and start the first I/O. However, a second I/O cannot be started until the first I/O is complete (data can only travel over a physical channel, not a logical channel). The crossbar card should be designed so as to stagger PSIAs.

The second area preventing effective I/O throughput is the method in which the Link Adapters (LA) are utilized. Each PSIA channel in the MPC shares a LA with another PSIA channel. Each LA can service only one PSIA at a time. The PSIAs are paired as 0-1, 2-3, etc. The crossbar card should be designed so as to prevent two I/Os in succession from going to the same LA.

The following procedure should be followed to determine if the crossbar card is properly designed:

- o List in a vertical column the order of the IOM/channels on the crossbar card.
- o Analyze the MPC card of the startup deck and next to each IOM/channel written in step 1, write the MPC/PSIA associated with that channel.
- o A problem exists if the same MPC/PSIA numbers appear consecutively. This is an indication of consecutive logical channels (problem type 1 above).
- o An indication of the Link Adapter conflict is the occurrence of two consecutive entries in the MPC/PSIA column with the same MPC number and consecutive PSIA numbers (0-1,2-3).

The following is an example of the above procedure:

<u>Cross Bar Cards</u>

```
    $ XBAR    IOM-0,PUB-10,IOM-1,PUB-10,
              IOM-2,PUB-10,IOM-2,PUB-11,
              IOM-1,PUB-11,IOM-0,PUB-11
```

```
$ XBAR     IOM-1,PUB-14,IOM-0,PUB-14
           IOM-2,PUB-14,IOM-2,PUB-13,
           IOM-0,PUB-13,IOM-1,PUB-13
```

MPC Cards

```
$ MPC-0    PSI-2,IOM-0,PUB-10,PSI-1,IOM-1,PUB-10,
           PSI-3,IOM-2,PUB-10,PSI-3,IOM-2,PUB-11,
           PSI-1,IOM-1,PUB-11,PSI-2,IOM-0,PUB-11

$ MPC-2    PSI-0,IOM-1,PUB-14,PSI-2,IOM-0,PUB-14
           PSI-1,IOM-2,PUB-14,PSI-1,IOM-2,PUB-13
           PSI-0,IOM-0,PUB-13,PSI-2,IOM-1,PUB-13
```

Chart

IOM/Channel	MPC/PSIA	IOM/Channel	MPC/PSIA
0-10	0-2	1-14	2-0
1-10	0-1	0-14	2-2
2-10	0-3 *	2-14	2-1
2-11	0-3	2-13	1-1 **
1-11	0-1	0-13	1-0
0-11	0-2	1-13	1-2

* problem 1
** problem 2

The problems described by the above procedures could be solved by redesigning the crossbar cards in the following manner:

```
$ XBAR     IOM-0,PUB-10,IOM-1,PUB-10,
           IOM-2,PUB-10,IOM-0,PUB-11,
           IOM-1,PUB-11,IOM-2,PUB-11

$ XBAR     IOM-1,PUB-14,IOM-0,PUB-14,
           IOM-2,PUB-14,IOM-1,PUB-13,
           IOM-0,PUB-13,IOM-2,PUB-13
```

If the I/O request cannot be granted, because either the channel or device being requested is currently busy, the request will be queued. This request will only be serviced when both a channel and device are free. When queuing occurs for a channel, GCOS will indicate the request queued over the primary channel. A primary channel is that channel which appears first on the $XBAR card, for a given string of devices. Therefore, all channel queue histograms are presented only for primary channels. However, a queue on the primary channel actually means that all channels, both physical and logical, connected to the desired device were busy. When the request is finally granted, a trace type 7 is issued.

A table is used to hold the device number, channel number, IOM number, I/O queue entry address, and the time the T22 trace event occurred. With the occurrence of each T22 event, the table entry is filled to mark the linking of the I/O requests. At this time, the required computations for determining the channel and device queue length are made. Channel queue histograms are produced for both tape and mass store devices, while device queue histograms are produced only for mass storage devices. The channel and device queue time also begins at this point and will be updated with the occurrence of the trace 7 event for this I/O request.

With the eventual occurrence of the trace 7 event for the I/O request, several updates are required to the common tables. The I/O queue time data are generated for the channel and device and collected for the appropriate histograms. It should be noted that it is possible for a device to show no queuing, but yet will display I/O queue time in its queue time histogram. The reason for this is that the queue time histogram is reporting the time difference between a T7 trace and a T22 trace. The T7 trace will not be issued until the actual I/O is initiated (i.e., a physical channel becomes available). Even though a logical channel might be available, several milliseconds might pass before a physical channel becomes available and the T7 trace is generated. Even if a physical channel is available, upon the occurrence of a T22 trace, several milliseconds might pass before the system generates the T7 event. This is especially true on a very busy system. A connect queue entry is now filled with data to be used for the I/O service time histograms. This connect queue holds the IOM, channel, device number, and the time of the trace 7 event. The channel and devices status table entries are also marked busy at this point. As a confidence test, the channel status is sensed at the start of processing for each trace 7 event for a nonbusy status. If it is busy, a lost interrupt is considered to have occurred since it is impossible for a connect to be issued to a busy device or channel. Device access histogram data and an IOM command execution count are also generated at trace 7 event time.

The next logical event for the I/O process is the termination interrupt originated by the IOM at the I/O data transfer completion. The signal for this event is transmitted by the IOM to the processor through the SCU as a request for the processor to service the I/O completion. The type 4 trace event contains the IOM number and channel for I/O termination. These data are used to determine the I/O service time by finding the time difference of the connect event and the terminate event. The time difference is collected and displayed in histogram form for each mass store and tape channel as well as for all mass store devices. The channel and device queue length are also adjusted at this point to reflect the absence of a queue being serviced for this channel and device.

It must be noted that exceptions to the normal I/O process are to be expected and must be accounted for in the reduction program. All the exceptions encountered so far have been diagnosed and coding in the program will allow for exceptions. Some of the exceptions include the following:

- System programs that avoid the T22 trace by generating their own queue entry and by starting the connect immediately.

- System programs that manipulate the I/O priority by linking themselves ahead of I/O requests already in the queue.

- I/O requests for device zero (MPC) which makes a channel busy but not a device.

- Lost interrupts from an I/O connect which leave the connect table and status table in an active state forever, if not detected.

- Special controller commands which do not involve the channel or device.

8.4 Data Reduction Methodology

The CMDRP currently uses random I/O (File 58) to process histogram data. This feature allows the CMDRP to process an unlimited number of channels/devices with a minor increase in memory requirements. As delivered, the CMDRP will process 75 mass storage devices and 40 mass storage/tape channels. It will produce 106 unique histograms with a minimum amount of random I/O. If the number of channels or devices is insufficient, the user will need to edit file B29IDPX0/SOURCE/CM. The user should enter the edit subsystem and process the following command:

```
B RS:/NRDEVXX=XX75/;*:/NRDEVXX=XX New number of devices/

B RS:/NRCHANXX=XX40/;*:/NRCHANXX=XX New number of channels/
```

For each additional channel the size of the program will increase by 55 words and for each additional device the program will increase by 25 words. In the above edit the character "X" signifies a single space.

The last variable that will need to be changed is RPTCNT. This number represents the total number of histograms that will be processed with negligible random I/O. To calculate the total number of histograms that will be produced under your configuration, the following formula should be used.

(number of mass store devices)*3 + (number of tape and mass store channels - both logical and physical) + (number of tape and mass store physical channels)*2.

If this value is less than 106 no change is required. If the value computed is greater than 106, the user may alter this value. This will help to decrease CPU/IO time but will increase storage by 80 words for each increment above 106. This tradeoff between CPU/IO time and memory must be

made at the discretion of the user. In order to change this value, the following edit function should be performed:

```
B RS:/RPTCNTX=106/;*:/RPTCNTX=New value
```

As in the earlier edit example, the character "X" should not be typed, but is being used to represent a blank column. After performing the above edits, the user should recompile the source program by entering the card subsystem and issuing a run command.

8.5 CMDRP Output

Reports generated from the Channel Monitor may vary from one collection period to another due to the difference in configuration of the hardware. Report numbers are preassigned to the histogram reports which are hardware independent and are dynamically assigned to histograms which denote the channel and device uniquely configured on each IOM.

The following subsections will describe all reports produced by the CMDRP and subsection 8.6 will describe the user input options.

8.5.1 System Configuration and Channel Usage Report (File 57). This report documents the system identification, configuration, and the date and time of the monitoring period, as well as reporting the usage of all configured I/O channels. Figure 8-2 is an example of this report. The heading line indicates the software version number that corresponds to this document. The version number should be 01-82. The first line after the heading provides the tape number(s) the report was generated from, the system identification, the date (in the form year, month, and day - YYMMDD), and the start and stop times (HH:MM:SS) of the MONITORING SESSION. The next several lines of output describe the overhead of all GMF monitors that were active during data collection. The monitor name is given, its CPU time in seconds, and its overhead as a function of total processor power. The GMF executive overhead is separated from the actual monitors and is listed as "EXEC". The monitor "NAME" is an area of code within the Mass Store Monitor and even though listed separately it is also included under the monitor "MSM". The monitor "FMS" is also an area of code within the Mass Store Monitor, but in this case it has not been included under the monitor "MSM".

Monitor "CM" in this report describes the processor overhead of subroutine T4 (terminate processing) and subroutine T22 (start I/O processing). Monitor "MSM" in this report describes the processor overhead of subroutine T7 (connect processing). Therefore, if the Channel Monitor was active, but the Mass Store Monitor was not, this report will still list both "CM" and "MSM" as contributing to the processor overhead. The total Channel Monitor overhead will be found by adding the overhead of the "CM" monitor to the overhead of the "MSM" monitor, to the overhead of the "FMS" monitor.

```
       ******************************************************
       * * *            C H A N N E L   M O N I T O R         * * *
       * * *                    VERSION  01-82                * * *
       ******************************************************

          TAPE # 24502
     SYSID                  DATE        START TIME     STOP TIME

     OSCC2 ,6.4.ID      82-01-08        13:49:04      14:31:40        FOR A TOTAL OF 0.71 HOURS

MONITOR OVERHEAD - MONITOR                   TIME(SEC)            % OVERHEAD
                    EXEC                        100                  1.96
                    MUM                         120                  2.35
                    MSM                         160                  3.13
                    NAME                         40                   .78
                    FMS                          50                   .98
                    TOTAL                                            8.42

CONFIGURATION:  DUAL    PROCESSOR 6680,  DUAL  IOM,  512K  MEMORY - 52 OF WHICH WERE HCM
                  THE HCM DOES NOT INCLUDE 3K FOR .CALC AND 6-8K FOR FILSYS
                CPUS ACTUALLY CONFIGURED = 2.00  CPUS ACTUALLY AVAILABLE = 1.75
                                      IOM NUMBER 0

     CHANNEL                TYPE           CROSSBAR       CONNECTS
      0-08                 .DS450             0-09          47750
                                              1-08
                                              1-09
      0-09                 .DS450          SEE ABOVE        16851
      0-12                 .DS191             0-13          55524
                                              1-12
                                              1-13
      0-13                 .DS191          SEE ABOVE         2479
      0-16                 .DS181             0-17           8290
                                              1-16
                                              1-17
      0-18                 .DMTA9             NONE             62
      0-19                 .DMTA9             NONE           9147

              (IN THE ACTUAL REPORT A SUMMARY OF IOM NUMBER 1 WOULD FOLLOW)
```

Figure 8-2. System Configuration and Channel Usage Report

If both the Channel Monitor and Mass Store Monitor were active, then the combined overhead of both monitors can be found as the sum of "MSM" + "CM" + "FMS".

For purposes of this report, % overhead is computed as:

$$\frac{\text{(CPU TIME Used by Monitor)}}{\text{(TOTAL Elapsed Time)x(Number of Processors)}}$$

Following the overhead description are three lines of configuration information describing the number of processors, IOMs, and amount of memory configured to the system. In addition, the size of GCOS Hard Core, the size of the Core Allocator and the size of FILSYS is also presented. The third line of the configuration data indicates the number of processors actually configured and actually available. These numbers might be different than shown on the first line due to the assigning and releasing of processors. In figure 8-2, we see that one processor was released for a period of time (i.e., CPUs actually available is equal to 1.75). The actual time that processors were available or released is indicated in the status message printouts (see subsection 8.5.15).

The next portion of the report documents the channel configuration by IOM, listing each configured channel number, the device type configured to that channel, and the channel crossbarring. The crossbar column shows those channels that are crossbarred to the channel identified under the channel column. If SEE ABOVE is found, the crossbarring has been displayed on a preceding channel. The I-CC format of each channel description identifies the IOM and the channel number being discussed. The last column of this report displays the number of all connect types issued over that channel. This section will be repeated for each IOM configured to the system. Figure 8-2 only displays IOM 0 activity. This report is always generated and cannot be turned off.

8.5.2 System Summary Report (File 57). The System Configuration and Channel Usage Report and the System Summary Report may be used to assess overall system utilization. Figure 8-3 is an example of the System Summary Report. The first set of lines shows the number of connects to the monitored mass storage subsystems compared to the total connects issued (TAPE+DISK) and the connect rate per hour over the subsystem. Most systems will show a small number of Control Connects being generated by the MPCs configured to the system. These Control Connects will be summed together and listed as a separate subsystem line. Analysis on a Shared Mass Storage System shows the number of MPC connects generated to be a significant percentage of the total connects generated. The final part of this report is a list of the commands (octal code and mnemonic) issued to the mass storage subsystem and the count of each issued during the monitoring session. This report is always generated and cannot be turned off.

```
**********************************************************************
  * * *       S Y S T E M   S U M M A R Y   R E P O R T       * * *
**********************************************************************

TOTAL CONNECTS TO DSS181          8540 OF    207117 ( 4%) AT A RATE OF      12024. PER HOUR
TOTAL CONNECTS TO DSS191         76949 OF    207117 (37%) AT A RATE OF     108341. PER HOUR
TOTAL CONNECTS TO MSO450        107273 OF    207117 (51%) AT A RATE OF     151036. PER HOUR
TOTAL CONNECTS TO MPC-CONTROL       12 OF    207117 ( 0%) AT A RATE OF         16. PER HOUR

                                   COMMAND              COUNT
                                01 CONTRL                  12
                                17 FMT TK               15485
                                25 READ                126899
                                26 RD CR                  192
                                31 WRITE                35483
                                33 WR-VER               12862
                                40 RST ST                1841
                                TOTAL                  192774
```

Figure 8-3. System Summary Report

A well performing system, under a heavy workload, should show a high utilization of the configured resources. Figure 8-3 shows that the I/O activity is predominantly on the MSU450 subsystem configured on channels 8 and 9 of IOM 0 and 1 (see figure 8-2). The MSU450s are receiving 51% of all connects and, therefore, should be the major area of concern. The access rate for every subsystem is reported on the top of the System Summary Report and it can be seen that the MSU450s have an access rate significantly higher than the other subsystems. All signs indicate that if system throughput is being affected by disk activity, then the MSU450s would be the probable cause of such problems.

The next item to check on these two reports should be the channel usage. The two highest used logical channels of any subsystem should be on a separate PSIA channel of a two-PSIA channel subsystem (see subsection 8.3). Referring to figure 8-2, one can see that logical channel 8 of IOM 0 and IOM 1 has the highest usage, and this is the proper configuration (refer to detailed description in subsection 8.3). If the highest used logical channels are not on separate PSIA channels, the $ XBAR card in the startup configuration section is suspected as the cause. The channels are used in the order given on the $ XBAR card (i.e., if the primary channel is busy, the next channel tried is given on the crossbar). The alternate use of PSIA channels for maximum simultaneity must, therefore, be appropriately specified in the boot deck.

While looking at the System Summary Report, it is also of interest to note the ratio of READ commands to WRITE commands (over two to one in this example). This gives an indication of the nature of the usage of the mass storage space. A quick look at the number of write/verify (WR-VER) commands executed is also of interest as they are essentially double (WRITE, then READ) data transfer commands which require more device and channel time.

The general fraction of utilization for each logical channel gives an indication of the degree of simultaneity of access to the subsystem. If only N of the configured logical channels have nonzero counts, then there were never more than N accesses being performed simultaneously by the subsystem. The proportional relationships among the counts of accesses made over each of the logical channels are quantitative indications of the frequency of occurrence of specific levels of simultaneity. As an example, if we look at figure 8-2, we see that only 4487 connects out a total of 107,273 connects went to Channel 9, IOM 1. This means that only 4487 times during the measuring period were all four MSU450 disk channels being utilized simultaneously. In this example, channel queuing (i.e., shortage of channel power) would not appear to be a problem. This is not to infer that device queuing is not a problem, just that channel queuing does not appear to be a problem. If the number of accesses to the lowest priority channel is a larger percentage of the total accesses, then channel queuing needs to be examined.

8.5.3 System Traces Captured by Monitor Report (File 57). This report contains the number of occurrences of each specific trace type recorded on the data collector tape processed by the CMDRP (figure 8-4). This report provides little, if any, information required by the user for his analysis. This report is always generated and cannot be turned off.

8.5.4 Channel Status Changes Report (File 57). This report lists the initial status for all tape and disk channels configured to the system (figure 8-5). If, during the course of the monitoring session, a given channel or IOM was dropped or added to the system (dynamic reconfiguration) a new report will be produced indicating the activation or deactivation changes and the time that the change occurred. Finally, this report will indicate whether the SSA cache option and FMS cache option are active, and if so, will indicate their initial status and any changes that occur to that status. If a given option is not active, a zero will be reported for each of the values. This report is always generated and cannot be turned off.

8.5.5 Physical Device, Device ID Correlation Table (File 57). Each mass storage device configured in the system is listed with a unique device ID. A typical report is presented in figure 8-6. This unique device is needed since different devices can have the same device number on the Honeywell 6000. (See Device ID 1, Device ID 7, and Device ID 18 of figure 8-6). These unique numbers are referenced in several reports produced by the CMDRP. This report is always generated and cannot be turned off.

8.5.6 Channel Statistics Report (File 57). The Channel Statistics Report is actually a series of reports used to summarize the queuing that occurred over the channels and devices. These reports are processed as a group and are produced by default. The entire series of reports can be turned off via the use of the "OFF" input option (see subsection 8.6.5).

8.5.6.1 Channel Busy and Device Busy Report. The Channel Busy and Device Busy Report is given in figure 8-7. These data are collected into an array during execution of the reduction program and indicates the number of times channel K and device N were both busy at the I/O request link time. Remember that this report is presented by primary channel. The primary channel is busy when all logical channels associated with the primary channel are busy.

8.5.6.2 Channel Busy and Device Free Report. The Channel Busy and Device Free Report, figure 8-8, is generated in a similar method to the Channel Busy and Device Busy Report. If a channel is busy a sufficient number of times, this will indicate the need for more channel power. If, for example, there are no more IOM ports available, a large amount of channel queuing can be a strong indication of the need for another IOM.

8.5.6.3 Channel Free and Device Busy Report. The Channel Free and Device Busy Report, figure 8-9, is generated in a similar manner to the previous

SYSTEM TRACES CAPTURED BY MONITOR REPORT

TRACE	COUNT	TRACE	COUNT	TRACE	COUNT	TRACE	COUNT	TRACE	COUNT	TRACE	COUNT	TRACE	COUNT	TRACE	COUNT
00	0	01	0	02	0	03	0	04	3214	05	0	06	0	07	3214
10	129	11	0	12	0	13	0	14	636	15	0	16	0	17	0
20	0	21	450	22	3214	23	0	24	0	25	0	26	0	27	0
30	0	31	0	32	0	33	0	34	0	35	0	36	0	37	0
40	0	41	0	42	0	43	0	44	0	45	0	46	15	47	0
50	21	51	0	52	0	53	0	54	0	55	0	56	0	57	0
60	0	61	0	62	0	63	0	64	0	65	0	66	0	67	0
70	0	71	0	72	0	73	0	74	0	75	0	76	0	77	0

Figure 8-4. System Traces Captured by Monitor Report

CHANNEL STATUS CHANGES REPORT FOR NMCC2 ON 80/09/20

IOM	CHANNEL	DEACTIVATE/ACTIVATE CHANGE	TIME
0	08	INITIAL ACTIVE	16:50:49.7
0	09	INITIAL ACTIVE	16:50:49.7
0	12	INITIAL ACTIVE	16:50:49.7
0	13	INITIAL ACTIVE	16:50:49.7
0	14	INITIAL ACTIVE	16:50:49.7
0	15	INITIAL ACTIVE	16:50:49.7
0	16	INITIAL ACTIVE	16:50:49.7
0	17	INITIAL ACTIVE	16:50:49.7
0	18	INITIAL ACTIVE	16:50:49.7
1	08	INITIAL ACTIVE	16:50:49.7
1	09	INITIAL ACTIVE	16:50:49.7
1	12	INITIAL ACTIVE	16:50:49.7
1	13	INITIAL ACTIVE	16:50:49.7
1	14	INITIAL ACTIVE	16:50:49.7
1	15	INITIAL ACTIVE	16:50:49.7
1	16	INITIAL ACTIVE	16:50:49.7
1	17	INITIAL ACTIVE	16:50:49.7

INITIAL VALUES FOR SSA CACHE - LAL, MBA, SIZE
000000200000 000000001566 10

INITIAL VALUES FOR FMS CACHE - ABS ADDR, MBA, OPTION WORD, #320 WORD BUFFERS
000000000000 000000000000 000000000000 0

Figure 8-5. Channel Status Changes Report

THE PHYSICAL DEVICE, DEVICE ID CORRELATION TABLE

```
DEVICE ID - 1 IS FOUND ON IOM-0 PUB-08 AND IS DEVICE #01
DEVICE ID - 2 IS FOUND ON IOM-0 PUB-08 AND IS DEVICE #02
DEVICE ID - 3 IS FOUND ON IOM-0 PUB-08 AND IS DEVICE #03
DEVICE ID - 4 IS FOUND ON IOM-0 PUB-08 AND IS DEVICE #04
DEVICE ID - 5 IS FOUND ON IOM-0 PUB-08 AND IS DEVICE #05
DEVICE ID - 6 IS FOUND ON IOM-0 PUB-08 AND IS DEVICE #06
DEVICE ID - 7 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #01
DEVICE ID - 8 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #02
DEVICE ID - 9 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #03
DEVICE ID -10 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #04
DEVICE ID -11 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #05
DEVICE ID -12 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #06
DEVICE ID -13 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #07
DEVICE ID -14 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #08
DEVICE ID -15 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #09
DEVICE ID -16 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #10
DEVICE ID -17 IS FOUND ON IOM-0 PUB-12 AND IS DEVICE #11
DEVICE ID -18 IS FOUND ON IOM-0 PUB-16 AND IS DEVICE #01
DEVICE ID -19 IS FOUND ON IOM-0 PUB-16 AND IS DEVICE #02
DEVICE ID -20 IS FOUND ON IOM-0 PUB-16 AND IS DEVICE #03
DEVICE ID -21 IS FOUND ON IOM-0 PUB-16 AND IS DEVICE #04
DEVICE ID -22 IS FOUND ON IOM-0 PUB-16 AND IS DEVICE #05
DEVICE ID -23 IS FOUND ON IOM-0 PUB-16 AND IS DEVICE #06
DEVICE ID -24 IS FOUND ON IOM-0 PUB-16 AND IS DEVICE #07
```

Figure 8-6. Physical Device, Device ID Correlation Table

CHANNEL BUSY AND DEVICE BUSY REPORT FOR NMCC2 ON 80-10-06								
CHANNEL	08	IOM	2	AND DEVICE	01	BOTH BUSY	928	TIMES
CHANNEL	08	IOM	2	AND DEVICE	02	BOTH BUSY	3270	TIMES
CHANNEL	08	IOM	2	AND DEVICE	03	BOTH BUSY	399	TIMES

Figure 8-7. Channel Busy and Device Busy Report

```
CHANNEL BUSY AND DEVICE FREE REPORT FOR NMCC2 ON 80-10-06
CHANNEL  08  ICM  2  BUSY AND DEVICE  01  NOT BUSY  1576  TIMES
CHANNEL  14  ICM  2  BUSY AND DEVICE  02  NOT BUSY     2  TIMES
CHANNEL  14  ICM  2  BUSY AND DEVICE  03  NOT BUSY     1  TIME
```

Figure 8-8. Channel Busy and Device Free Report

AD-A116 898 COMMAND AND CONTROL TECHNICAL CENTER WASHINGTON DC F/G 17/2
GENERALIZED MONITORING FACILITY. USERS MANUAL.(U)
MAY 82 B WALLACK, G H GERO
UNCLASSIFIED CSM-UM-246-82 NL

4 OF 6
ADA
116898

CHANNEL FREE AND DEVICE BUSY REPORT FOR NMCC2 ON 80-10-06

CHANNEL	08	IOM	0	NOT BUSY AND DEVICE	01	BUSY	1858	TIMES
CHANNEL	08	IOM	0	NOT BUSY AND DEVICE	02	BUSY	410	TIMES
CHANNEL	12	IOM	0	NOT BUSY AND DEVICE	01	BUSY	10	TIMES
CHANNEL	12	IOM	0	NOT BUSY AND DEVICE	02	BUSY	698	TIMES

Figure 8-9. Channel Free and Device Busy Report

two reports. It is an indication of the number of times that an I/O request was queued because the device was busy but there were available channels. Significant values in this report would be an indication that possible relocation of files is required. The Mass Store Monitor can be used with this data tape to determine the files being accessed on this device.

8.5.6.4 Channel Free and Device Free Report. The Channel Free and Device Free Report, figure 8-10, is an indication of the number of I/O requests that were executed by IOS immediately, without any queuing.

8.5.6.5 GEPR Connect Report. The GEPR Connect Report, figure 8-11, shows the number of times that a trace type 7 was processed, without a preceding trace type 22. This unexpected sequence of traces is supposed to occur whenever the system processes a GEPR (I/O error) event. During data collection, the CM captures an I/O status word indicator and the data reduction program checks this status word to verify that a GEPR has actually occurred. This report will indicate how many confirmed GEPRs (i.e., the status word was set) have occurred and how many suspected GEPRs have occurred (i.e., the status word was not set). This report will be of little aid to the analyst and CCTC is still investigating the reason for this trace occurrence, when the status word is not set.

8.5.6.6 Lost Interrupt Report. The Lost Interrupt Report, figure 8-12, indicates that a trace type 7 is being processed for a busy device and/or channel. This is an impossible event and is an indication that a trace type 4 has not been generated. This is usually an indication that the system has generated a lost interrupt. However, if lost data has been generated during data collection, this report may indicate many lost interrupts, which really did not occur.

8.5.6.7 Device ID STIOS Not Connected Report. The Device ID STIOS Not Connected Report, figure 8-13, shows the number of start I/Os that were dropped for each device. A start I/O is dropped when it is found that a STIO trace has occurred for a device and within a user-defined timeframe (5-second default), no connect has been received for the start. The cause of this condition currently is under analysis. This report is also presented by the device ID and must be correlated by using the Device ID Correlation Report.

8.5.6.8 Entries Still in Queue Report. The Entries Still in Queue Report, figure 8-14, shows all entries remaining in the CMDRP queues. This report shows the device number, channel number, IOM number, queue location, and time (in milliseconds) the entry has been in the queue. These entries were active when the monitor terminated.

8.5.7 Idle Monitor Report (File 57). If the Idle Monitor was active when the Channel Monitor was running an Idle Report will be produced next (see figure 8-15). The first few lines will indicate, for each processor, the

CHANNEL FREE AND DEVICE FREE REPORT FOR OSCC2 ON 79-12-06

CHANNEL	08	IOM	0	AND	DEVICE	01	FREE	15285	TIMES
CHANNEL	08	IOM	0	AND	DEVICE	02	FREE	4114	TIMES
CHANNEL	08	IOM	0	AND	DEVICE	03	FREE	31540	TIMES
CHANNEL	08	IOM	0	AND	DEVICE	04	FREE	13094	TIMES
CHANNEL	08	IOM	0	AND	DEVICE	05	FREE	4292	TIMES
CHANNEL	08	IOM	0	AND	DEVICE	06	FREE	1007	TIMES
CHANNEL	12	IOM	0	AND	DEVICE	01	FREE	3290	TIMES
CHANNEL	12	IOM	0	AND	DEVICE	02	FREE	7012	TIMES
CHANNEL	12	IOM	0	AND	DEVICE	03	FREE	2724	TIMES
CHANNEL	12	IOM	0	AND	DEVICE	04	FREE	3558	TIMES
CHANNEL	12	IOM	0	AND	DEVICE	05	FREE	3626	TIMES
CHANNEL	12	IOM	0	AND	DEVICE	06	FREE	8781	TIMES
CHANNEL	12	IOM	0	AND	DEVICE	07	FREE	890	TIMES
CHANNEL	12	IOM	0	AND	DEVICE	08	FREE	15285	TIMES
CHANNEL	12	IOM	0	AND	DEVICE	09	FREE	1087	TIMES
CHANNEL	12	IOM	0	AND	DEVICE	10	FREE	4147	TIMES
CHANNEL	12	IOM	0	AND	DEVICE	11	FREE	18330	TIMES
CHANNEL	16	IOM	0	AND	DEVICE	01	FREE	892	TIMES
CHANNEL	16	IOM	0	AND	DEVICE	02	FREE	456	TIMES
CHANNEL	16	IOM	0	AND	DEVICE	03	FREE	456	TIMES
CHANNEL	16	IOM	0	AND	DEVICE	04	FREE	456	TIMES
CHANNEL	16	IOM	0	AND	DEVICE	05	FREE	456	TIMES
CHANNEL	16	IOM	0	AND	DEVICE	06	FREE	456	TIMES
CHANNEL	16	IOM	0	AND	DEVICE	07	FREE	456	TIMES

Figure 8-10. Channel Free and Device Free Report

GEPR CONNECT REPORT FOR NMCC2 ON 82-01-19

```
CHANNEL  08  IOM  0  DEVICE  05  #  OF CONFIRMED GEPRS    0  #  OF SUSPECTED GEPRS    23
CHANNEL  08  IOM  0  DEVICE  07  #  OF CONFIRMED GEPRS    0  #  OF SUSPECTED GEPRS    13
CHANNEL  08  IOM  0  DEVICE  09  #  OF CONFIRMED GEPRS    0  #  OF SUSPECTED GEPRS     9
CHANNEL  08  IOM  0  DEVICE  11  #  OF CONFIRMED GEPRS    0  #  OF SUSPECTED GEPRS    19
CHANNEL  12  IOM  0  DEVICE  15  #  OF CONFIRMED GEPRS    0  #  OF SUSPECTED GEPRS     5
CHANNEL  14  IOM  0  DEVICE  05  #  OF CONFIRMED GEPRS    0  #  OF SUSPECTED GEPRS    26
```

Figure 8-11. GEPR Connect Report

```
LOST INTERRUPT REPORT FOR NMCC2 ON 80-10-06

IOM  0  PUB  12  LOST INTERRUPT COUNT     1
```

Figure 8-12. Lost Interrupt Report

```
DEVICE ID STIOS NOT CONNECTED FOR NMCC2 ON 80-10-06

DEVICE ID   8  # OF STARTS DROPPED     1

DEVICE ID  10  # OF STARTS DROPPED     1
```

Figure 8-13. Device ID STIOS Not Connected

ENTRIES STILL IN QUEUE FOR NMCC2 ON 80-10-06

DEVICE #	CHA #	IOM	QUEUE	TIME IN QUEUE(MS)
20	12	0	189088	33

Figure 8-14. Entries Still in Queue

IDLE REPORT FOR SYSTEM OSCC2 ON 79-07-13

PROCESSOR 0 WENT IDLE 101934 TIMES FOR A % IDLE OF 38

PROCESSOR 1 WENT IDLE 64039 TIMES FOR A % IDLE OF 29
AVERAGE SYSTEM % IDLE WAS 34
% OF IDLE TIME DURING WHICH IO WAS ACTIVE 100
AVERAGE NUMBER OF OUTSTANDING IO's WHEN THE SYSTEM WENT IDLE WAS 7

DEVID	% OF IDLE TIME WITH ACTIVE IO	AVERAGE QUEUE SIZE
1	95	4.66
2	12	0.19
3	21	0.33
4	46	1.16
8	3	0.05
10	1	0.02
11	1	0.02
14	71	0.76
15	4	0.08
16	1	0.02
24	1	0.02

Figure 8-15. Idle Report

number of times that processor went idle and the percent idleness of the that processor. This is followed by an average idle percentage for the entire system. The next line of output indicates for what percentage of system idle time there was active disk I/O; i.e., I/O in progress or I/O request queued. This figure would give a good indication as to whether the CPU is going idle because of a lack of work or rather because work is being delayed by the slower peripheral devices. In figure 8-15, we see that for 100 percent of the idle time, the CPU was actually waiting on disk I/O to be performed. In this case, the CPU could be put to better utilization, if only the speed of the disk subsystem could be increased. The next line of output indicates how many outstanding I/Os were present when the system went idle.

Following this output, a table is generated for every disk device that had any active I/O on it when the CPU went idle. For each such device, the percent of Idle Time during which it had active I/O and the average queue size at that time is given. In figure 8-15, we see that during 95 percent of CPU idle time device ID #1 had outstanding I/O to an average length of 4.66. Device #4 had active I/O for 46 percent of the CPU idle time with an average length of 1.2. By examining this report, we can see that if the queues on these two devices could be reduced there is sufficient CPU power available to handle the additional workload that would be generated. As with earlier reports, the Device ID Correlation Report should be used to convert a unique device ID into an IOM, PUB, device number.

8.5.8 Proportionate Device Utilization Report (File 57). This report shows the proportionate utilization of each device configured on the mass storage subsystem. Figure 8-16 is an example. This histogram identifies each unique device ID (device number zero is an MPC controller) and provides both a count of the number of accesses made to each device (under the column headed INDIV. NUMBER) as well as the percent of all accesses which were to each device (under the column headed INDIV. PRC). The histogram shows the proportionate utilization of each device (i.e., the percent of all accesses which went to each device) in a graphical form. The physical device that each "Device ID" of the histogram represents is shown in the Physical Device ID Correlation Table (see figure 8-6). This report is always generated and cannot be turned off. In this report the user is looking for a device or devices which have significantly more utilization than others in the system. This highly used device would then be a potential bottleneck.

It is desirable, but not always practical, to have equal utilization for each device. The user should be reminded that data in figure 8-16 is cumulative over the monitoring period. The actual accessing pattern could have been periodic with the following form: Many accesses to device 4 followed by many accesses to device 3 followed by many accesses to device 2 followed by many accesses to device 1, etc. Each device could have been a bottleneck for a subperiod of the total monitoring period. This could also

```
                    DISTRIBUTION COLLECTED ON SYSTEM OSCC2 AT 13:49:04 ON 81-09-28

                                DEVICE UTILIZATION BY DEVICE NUMBER

INDIV.   CUMUL.   CUMUL.   INDIV.  DEVICE              PERCENT OF OCCURRENCE                   REPORT
NUMBER   NUMBER    PRC      PRC      ID       00   05   10   15   20   25   30   35   40   45   50    1
                                              I....I....I....I....I....I....I....I....I....I....I
    12       12    0.000    0.000    0-   0   I
 18947    18959    9.835    9.828    1-   1   Ixxxxxxxxxx
  8206    27165   14.091    4.257    2-   2   Ixxxx
 20269    47434   24.606   10.514    3-   3   Ixxxxxxxxxxx
 34033    81467   42.260   17.654    4-   4   Ixxxxxxxxxxxxxxxxxx
   238    81705   42.384    0.124    5-   5   I
 25580   107285   55.653   13.269    6-   6   Ixxxxxxxxxxxxx
     .        .        .        .     .   .   .
     .        .        .        .     .   .   .
     .        .        .        .     .   .   .

192774 ENTRIES                   0 OUT OF RANGE
```


Figure 8-16. Proportionate Device Utilization Report

have been the case if the proportionate utilization of each device was equal. The Channel Monitor can be used to uncover this cyclic type of usage. In addition, the Chronological Device Utilization Report (see subsection 7.5.18) was designed to uncover this type of problem by breaking down device utilization over time, rather than by utilizing a histogram. Nevertheless, when a single or small number of devices has a disproportionately large share of the accesses, they are potential bottlenecks and their usage should be further analyzed.

This report will show all connects that were issued to a given device. This includes all read/write connects, as well as any command type connects issued to a given device.(See subsection 7.3).

8.5.9 Queue Length and Queue Time Histograms (File 57). Figure 8-17 shows the I/O queue length and queue time histograms for the I/O requests to devices as they are processed by IOS. These reports occur in pairs, one pair for each device. These reports are generated only for mass store devices. The first report in the pair is a length report and the second is a time report. The histogram is read in the same manner as the Proportionate Device Utilization Report. In addition to individual percentages, cumulative percentages are also reported. In figure 8-17 (part 2) we see that 99.457% of all requests have a queue time of 12 ms or less while 99.674% of all requests have a queue time of 22 ms or less. The number of entries in these two reports might not be equal. The first report is generated at the time of the request. When an I/O request is made, an entry is made to the histogram indicating the number of requests outstanding or in progress to this device. The second report is generated at the time of the actual connect and indicates the length of time between the request and the actual connect. Since observations have indicated that some STIOS are never connected, the first report may have a higher number of entries than the second. These two reports can be correlated by subtracting the number of STIOS not connected, for a given device, from the number of entries in the queue length histogram. As an example, in figure 8-17 (part 1) we have a total of 921 entries. However, figure 8-17 (part 2) shows only 920 entries. If we now check figure 8-13 for this device (ID #10) we find a total of 1 entry reported. If this figure is subtracted from 921, the two reports correlate.

Figure 8-18 shows the channel queue length and queue time for the I/O queue entries as they are used in the system channel environment. These histograms will be produced for both mass store and tape channels. Once again, the number of entries in these figures will not correlate because of STIOS issued over a given channel, and not over a single device. On the system used for generating the figures in this document, devices 8, 10 and 20 are configured on IOM-0 PUB-12. If we add all references to these devices (see figure 8-13), we have a total of 2. In addition, if we add in references to those devices from figure 8-14 (entries that are still in the queue), the two figures will correlate.

```
DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:44:41 ON 80-10-06

I-O QUEUE LENGTH FOR IOM-0,PUB-12,DEVICE-04-- DSS191          DA4

INDIV.   CUMUL.   CUMUL.    INDIV.   QUEUE               PERCENT OF OCCURRENCE                  REPORT
NUMBER   NUMBER    PRC       PRC     LENGTH  00   10   20   30   40   50   60   70   80   90   100   33
                                             I....I....I....I....I....I....I....I....I....I....I
 914      914     99.240    99.240    0- 0   IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   7      921    100.000     0.760    1- 1   I

921 ENTRIES TOTAL     AVERAGE =    0.00760   VARIANCE =    0.008    STANDARD DEVIATION =    0.087
```

Figure 8-17. Device Queue Length and Time Histograms (Part 1 of 2)

```
              DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:44:41 ON 80-10-06

              I-O QUEUE TIME-MS FOR IOM-0,PUB-12,DEVICE-04-- DSS191          DA4

INDIV.  CUMUL.   CUMUL.   INDIV.   QUEUE              PERCENT OF OCCURRENCE               REPORT
NUMBER  NUMBER   PRC      PRC      TIME    00  10  20  30  40  50  60  70  80  90  100   34
                                           I....I....I....I....I....I....I....I....I....I....I
 913     913     99.239   99.239    2.000  IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   0     913     99.239   0.        4.000  I
   0     913     99.239   0.        6.000  I
   0     913     99.239   0.        8.000  I
   1     914     99.348   0.109    10.000  I
   1     915     99.457   0.109    12.000  I
   0     915     99.457   0.       14.000  I
   0     915     99.457   0.       16.000  I
   0     915     99.457   0.       18.000  I
   1     916     99.565   0.109    20.000  I
   1     917     99.674   0.109    22.000  I
   0     917     99.674   0.       24.000  I
   0     917     99.674   0.       26.000  I
   0     917     99.674   0.       28.000  I
   1     918     99.783   0.109    30.000  I
   1     919     99.891   0.109    32.000  I
   0     919     99.891   0.       34.000  I
   0     919     99.891   0.       36.000  I
   0     919     99.891   0.       38.000  I
   0     919     99.891   0.       40.000  I
   0     919     99.891   0.       42.000  I
   0     919     99.891   0.       44.000  I
   1     920    100.000   0.109    46.000  I

920 ENTRIES TOTAL      AVERAGE =    0.18161    VARIANCE =    5.347    STANDARD DEVIATION =    2.312
```

Figure 8-17. (Part 2 of 2)

```
                    DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:44:41 ON 80-10-06

                                  I-O QUEUE LENGTH FOR IOM-0,PUB-12

INDIV.   CUMUL.   CUMUL.    INDIV.   QUEUE               PERCENT OF OCCURRENCE                 REPORT
NUMBER   NUMBER   PRC       PRC      LENGTH   00   10   20   30   40   50   60   70   80   90   100     6
                                              I....I....I....I....I....I....I....I....I....I....I
 9048     9048    100.000   100.000   0-  0   IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

9048 ENTRIES TOTAL   AVERAGE =   0.    VARIANCE =   0.    STANDARD DEVIATION =   0.
```

Figure 8-18. Channel Queue Length and Queue Time Report (Part 1 of 2)

```
                 DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:44:41 ON 80-10-06

                              I-O QUEUE TIME-MS FOR IOM-0,PUB-12

INDIV.  CUMUL.   CUMUL.   INDIV.   QUEUE              PERCENT OF OCCURRENCE               REPORT
NUMBER  NUMBER   PRC      PRC      TIME     00   10   20   30   40   50   60   70   80   90   100    7
                                            I....I....I....I....I....I....I....I....I....I....I
 9045    9045    100.000  100.000  2.000    IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

 9045 ENTRIES TOTAL    AVERAGE =    0.     VARIANCE =    0.     STANDARD DEVIATION =    0.
```

Figure 8-18 (Part 2 of 2)

In determining the length of a channel queue, the following is considered:

- o A channel queue of length 0 exists when there is at least one nonbusy, primary/logical channel.

- o When all primary/logical channels become busy, the length of the channel queue is calculated by summing the length of all device queues on that channel.

- o As an example, assume we had two channels configured with three devices. If device 1 became busy and 4 more requests were made for that device, we would have a device queue of 4 and a channel queue of 0. If during the same time, device 2 received 3 requests, we would generate a queue length 2 for that device but the channel queue would still remain at 0. In the situation described thus far, device contention, not a shortage of channels, is the problem. If we now assume that a connect was issued to device 3, we have now created a channel problem. There is no available channel for the I/O request. At this point, a channel queue of 7 (4 requests for device 1 + 2 requests for device 2 + 1 request for device 3) would be generated. Thus, we see that channel queues may increase in a nonsequential fashion.

8.5.10 <u>Service Time Histograms (File 57)</u>. In all of the device histograms, it should be noted that the name of the device is also given. In figure 8-17, queuing statistics were presented for a device with the name DA4. If an exchange took place and the DA4 disk pack was moved from 0-12-04 to 0-12-07, *the data reduction program* will account for that exchange and any connects that are made to 0-12-07 will be reported on this histogram and not to the 0-12-07 histogram.

In the upper right-hand corner of the report, a report number is indicated. This report number is used only to distinguish one histogram from another and in no way indicates the device to which the report refers. In addition, report numbers may not appear sequentially and this in no way is indicative of a problem. All histogram reports are always generated and cannot be turned off.

Figure 8-19 shows the I/O service time histograms for each I/O channel and device. Each histogram is given in 2ms intervals. The I/O service time is defined as the time (in ms) from connect to the time that IOS processes the terminate interrupt for the I/O request. These histograms are generated for both mass store and tape channels, as well as all mass store devices. On the bottom line of this report, an indication is given as to the percent of total time that this device or channel was busy.

The three device-oriented histograms, just described, have entries placed in them for every connect issued to the device (not just multicommands such as seek-read or seek-write).

```
                 DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:44:41 ON 80-10-06

                           I-O SERVICE TIME (MS) FOR IOM-0,PUB-14

INDIV.    CUMUL.    CUMUL.     INDIV.   SERIVCE              PERCENT OF OCCURRENCE                    REPORT
NUMBER    NUMBER    PRC        PRC      TIME      00   05   10   15   20   25   30   35   40   45   50   103
                                                  I....I....I....I....I....I....I....I....I....I....I
  10        10      45.455     45.455    2.000    IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
   5        15      68.182     22.727    4.000    IXXXXXXXXXXXXXXXXXXXXXXX
   2        17      77.273      9.091    6.000    IXXXXXXXXX
   0        17      77.273     0.        8.000    I
   0        17      77.273     0.       10.000    I
   0        17      77.273     0.       12.000    I
   0        17      77.273     0.       14.000    I
   0        17      77.273     0.       16.000    I
   0        17      77.273     0.       18.000    I
   0        17      77.273     0.       20.000    I
   .         .         .        .          .      .
   .         .         .        .          .      .
   .         .         .        .          .      .

22 ENTRIES TOTAL    AVERAGE =   9.42141    VARIANCE =   203.826    STANDARD DEVIATION =   14.277
                                                                               % BUSY =    0.03
```

Figure 8-19. I/O Service Time Report (Part 1 of 2)

```
                 DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:44:41 ON 80-10-06

                 I-O SERVICE TIME (MS) FOR [illegible]-0,PUB-12,DEVICE-10-- DSS191       DBO

INDIV.   CUMUL.   CUMUL.   INDIV.   SERIVCE           PERCENT OF OCCURRENCE                REPORT
NUMBER   NUMBER   PRC      PRC      TIME     00   05   10   15   20   25   30   35   40   45   50    53
                                             I....I....I....I....I....I....I....I....I....I....I
   3        3     13.043   13.043    2.000   IXXXXXXXXXXXXX
   1        4     17.391    4.348    4.000   IXXXX
   2        6     26.087    8.696    6.000   IXXXXXXXXX
   2        8     34.783    8.696    8.000   IXXXXXXXXX
   0        8     34.783    0.      10.000   I
   2       10     43.478    8.696   12.000   IXXXXXXXXX
   2       12     52.174    8.696   14.000   IXXXXXXXXX
   5       17     73.913   21.739   16.000   IXXXXXXXXXXXXXXXXXXXXXX
   .        .        .        .        .     .
   .        .        .        .        .     .
   .        .        .        .        .     .

23 ENTRIES TOTAL  AVERAGE =  14.01183   VARIANCE =  97.224   STANDARD DEVIATION =  9.860
                                                                      % BUSY =  0.04
```

Figure 8-19. (Part 2 of 2)

8.5.11 Activity Statistic Report (Files 23 and 24). Figure 8-20 shows the Activity Statistical Report (Parts 1 and 2). For each activity run in the system, Part 1 of this report displays the SNUMB, the activity number, the queue time (in .1 sec) that the activity accumulated for tapes and disks, the connect time (in .1 sec) that the activity accumulated for tapes and disk, and finally, the IDENT and USERID of the activity. The connect time on this report is computed by using as the start time the issuance of trace 7 and as the stop time the issuance of a trace 4. The value output in this report may differ significantly from the value output by SCF. In the opinion of CCTC (C751), the value given by this report more closely approximates the true connect time for an activity. Part 2 of this report gives the number of connects issued to tape and disk by each SNUMB and activity number, and the average queue time for each connect.

By using this report, it is possible to determine those activites which are being queued the most. By examining Mass Store Monitor output for these activities, it could be determined what files and packs were referenced by the activity and possibly some file reorganization could be performed.

System Schedular information for each activity (activity 0) is not reported separately. All activity 0 data is accumulated and reported as a single entry under the SNUMB $GENB.

From all the reports produced thus far, it is still not possible to determine if particular jobs are in conflict with each other. This information would be extremely useful in being able to move conflicting program files to different disk packs or in scheduling conflicting jobs during different times of the day. There is a CMDRP option that allows the user to obtain a Job Conflict Report for up to four unique devices (see subsection 8.5.12). The user would first determine those devices displaying the largest degree of queuing, or those devices containing the files of the programs receiving the largest queue times and rerun the CMDRP requesting the Job Conflict Report option (see subsection 8.6.1).

8.5.12 Job Conflict Report (Files 31, 32, 33, 34). In figure 8-21, we have a Job Conflict Report for Device ID #10. The first line of the report will give the date, time, and system name on which the data was collected. A separate report will be produced for each device requested by the user with the Device ID number appearing in the upper right hand corner of the report. The first column of the report will list the SNUMB/Activity Number of every job that was queued or caused some other job to be queued on this particular device. The USERID and IDENT for this SNUMB is also reported. Under the column "QUEUED BY" will appear a list of SNUMBs that caused such a delay. For example, $CALC was delayed by $ PALC 1 time and by $ SYOT 1 time. Under the column "QUEUED" will appear a list of SNUMBs that were delayed by this particular job and the number of times this delay occurred. Therefore, $CALC delayed $ GENB 1 time and itself just one time. Anytime that a given job has been queued by, or queued, 20 different

ACTIVITY STATISTIC REPORT PART 1 FOR NMCC2 ON 80-10-06

SNUMB ACTIVITY	QUEUE TIME (.1 SEC) TAPES	DISK	CONNECT TIME (.1 SEC) TAPES	DISK	IDENT	USERID
7151T- 1	0	0	0	16	1820020/30/6031,BETTY LAFAVERS	DJ3JI32419
TEST - 1	0	0	0	11	1820251/30/2773,C751	DJ8XI70203
7170A- 1	0	0	0	4	XXXNO,SC-PURGE	OPNSUTIL
7170A- 2	12	0	100	65	XXXNO,SC-PURGE	OPNSUTIL
$CALC- 0	0	1	0	49		
$PALC- 1	5	3	1	124		
$SYOT- 0	0	0	0	18		
$RTIN- 0	0	0	0	10		
TSS - 1	0	0	0	167		
$TOLT- 0	0	0	0	15		
$LOGN- 0	0	0	0	2		
NCP - 1	0	0	0	6		
$GENB- 0	0	7	0	1580		
DMSTA- 1	0	0	0	217	ZZZ,OPNSTIL	OPNSUTIL
TEST - 1	0	0	0	10	1820251/30/2773,C751	DJ8XI70203
7170A- 3	0	0	0	2	XXXNO,SC-PURGE	OPNSUTIL
MUM - 1	1	0	235	2	ZZZ,OPNSTIL	OPNSUTIL
HEALS- 1	0	0	0	4	ZZZ,OPNSTIL	HEALS-DATA

Figure 8-20. Activity Statistic Report (Part 1 of 2)

ACTIVITY STATISTIC REPORT PART 2 FOR NMCC2 ON 80-10-06

SNUMB	NUMBER OF CONNECTS ISSUED		AVERAGE QUEUE TIME (MILSEC) PER CONNECT	
ACTIVITY	TAPE	DISK	TAPE	DISK
7151T- 1	0	100	0	0
TEST - 1	0	39	0	0
7170A- 1	0	19	0	0
7170A- 2	658	668	1	0
$CALC- 0	0	261	0	0
$PALC- 1	172	1197	2	0
$SYOT- 0	0	101	0	0
$RTIN- 0	0	54	0	0
TSS - 1	0	516	0	0
$TOLT- 0	0	105	0	0
$LOGN- 0	0	3	0	0
NCP - 1	0	29	0	0
$GENB- 0	0	7287	0	0
DMSTA- 1	0	1728	0	0
TEST - 1	0	39	0	0
7170A- 3	0	14	0	0
MUM - 1	166	15	0	0
HEALS- 1	0	106	0	0

Figure 8-20. (Part 2 of 2)

```
JOB DEVICE CONFLICT REPORT COLLECTED ON 06-10-80 AT 11:45 FOR SYSTEM NMCC2 FOR DEVICE ID 10
  SNUMB/ACT  USERID        QUEUED BY  TIMES  QUEUED    TIMES  IDENT

  7151T-  1  DJ3JI32419                      $SYOT-  0   1     1820020/30/6031,BETTY LAFAVERS
                           $SYOT-  0    1
                      ****************************************************************************
  $CALC-  0                                  $GENB-  0   1
                                             $CALC-  0   1
                           $PALC-  1    1
                           $SYOT-  0    1
                           $CALC-  0    1
                      ****************************************************************************
  $PALC-  1                                  $CALC-  0   1
                      ****************************************************************************
  $SYOT-  0                                  7151T-  1   1
                                             $CALC-  1   1
                           7151T-  1    1
                      ****************************************************************************
  $GENB-  0                $CALC-  0    1
                      ****************************************************************************
  7170A-  2  OPNSUTIL                        7170A-  2   1     XXXNO,SC-PURGE
                           7170A-  2    1
                      ****************************************************************************

THE TOTAL NUMBER OF CONNECTS QUEUED ON THIS DEVICE WAS        7
```

Figure 8-21. Job Conflict Report

SNUMBs, it will be dumped out. This dumping is due to internal array size restrictions. When this dump is performed a message will be printed. No data will be lost and this job will appear again.

This report allows the user to identify exactly which programs are causing the queuing on a given device. The Mass Store Monitor reports can then easily be used to determine the program files on this device that are in conflict.

8.5.13 Special Job Processing Report by Device (File 32). The user has the option of producing two special reports that describe in detail the queue and service times being obtained by Specific Jobs. These reports can be obtained by invoking the "JOB" input option (see subsection 8.6.10). In the Activity Statistic Report (subsection 8.5.11), the total queue time and total service time for every activity processed during the session is reported. In the Special Job Processing Report by Device, these figures are displayed in detail by device number. In this way, it is possible to determine which device/devices are contributing the most to the total queue/service times obtained by a job. Each line of the report (see figure 8-22) describes the service being received by a job (column 1) for a particular device (column 2). The device number can be related to a particular disk drive by using the Device ID Correlation Report (figure 8-6). If a job references more than 25 unique devices, only the first 25 devices referenced will be reported. Column 3 provides the total queue time in milliseconds and column 5 provides the total service time in milliseconds. Column 7 provides the total number of connects issued by this job to this device.

Columns 4 and 6 provide average queue and service times (column 3/7 and column 5/7 respectively). The final column indicates what percentage of the job's total connects were processed on this particular device.

8.5.14 Special Job Processing Report Per 10 Minutes (File 32). The second of the special reports produced by the "JOB" input option is shown in figure 8-23. This report is produced by default every 10 minutes but the user can alter this time restriction by using the "RATE" option (see subsection 8.6.11). Figure 8-23 was produced at 5-minute intervals. This report provides similar information to that described in subsection 8.5.13 except that it is reported for the total job activity, not broken down by individual devices. This report can be very useful in tracking job performance over time. Particular times of day when queue time is substantially higher than normal can be identified. A correlation between the Response Time of TS1, or HI-TRAX, over time (as reported by the Communications Monitor), can be made with this report. If job performance (TS1, FTS, TELNET, HI-TRAX, etc.) is known to be unacceptable at certain times of day, this report can be used to see if the unacceptable performance was due to excessive delay in the I/O subsystem performance.

SPECIAL JOB PROCESSING REPORT BY DEVICE FOR SYSTEM NMCC2 ON 82-01-19

SNUMB	DEVICE #	TOTAL QUEUE	AVERAGE TIME(MS)	TOTAL SERVICE	AVERAGE TIME(MS)	TOTAL CONNECTS	% OF TOTAL CONNECTS
TS1	32	394	3	2122	20	102	0.29
TS1	31	0	0	5	5	1	0.00
TS1	35	0	0	55	18	3	0.01
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
2460T	1	114047	1	1498991	16	91231	56.35
2460T	21	6244	0	564632	12	43668	26.97
2460T	4	13615	2	114371	25	4558	2.82
2460T	3	9327	1	109815	18	5866	3.62
2460T	2	19352	1	248906	16	14726	9.10
2460T	22	168	0	18256	17	1064	0.66
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.

Figure 8-22. Special Job Processing Report By Device

SPECIAL JOB PROCESSING REPORT PER 5 MINUTE REPORT FOR SYSTEM NMCC2 ON 82-01-19

TIME	SNUMB	TOTAL QUEUE	AVERAGE TIME(MS)	TOTAL SERVICE	AVERAGE TIME(MS)	TOTAL CONNECTS
1300	TS1	36	0	3687	41	89
1300	2460T	4696	0	169300	14	11999
1300	BARRY	NOT CURRENTLY ACTIVE				
1300	NCP	NOT CURRENTLY ACTIVE				
1300	TOTAL	9185	0	304378	17	17223
1305	TS1	2612	2	36967	33	1107
1305	2460T	9548	1	156430	17	8971
1305	BARRY	NOT CURRENTLY ACTIVE				
1305	NCP	77	4	781	41	19
1305	TOTAL	30326	1	568022	23	23718
1310	TS1	3785	3	47657	38	1241
1310	2460T	5018	0	175921	16	10984
1310	BARRY	NOT CURRENTLY ACTIVE				
1310	NCP	1205	21	2694	48	56
1310	TOTAL	26197	1	607949	31	19171

Figure 8-23. Special Job Processing Report Per 5 Minute Report

8.5.15 Special Processing Messages. During the course of processing, several special processing messages may be generated by the CMDRP. Most of these are for information purposes only and can be ignored by the analyst. Following is a list and brief explanation of the most common messages.

- MONITOR MUM WAS ACTIVE . . . .
  This message is produced for each monitor that was active during the monitoring session.

- RUN BEING TERMINATED. DATA FOR MONITOR CM . . . .
  The CM was not active and so no reports can be produced.

- PROCESSOR #N IS (AVAILABLE/RELEASED) AT (TIME)
  This message will indicate the assignment or releasing of processors and provides the processor number involved as well as the time of day the assignment/releasing of processors occurred.

- FOLLOWING INPUT OPTIONS HAVE BEEN CHOSEN
  An echo print of all nonstandard input options selected will be produced. If any input option is described incorrectly, an error message will be generated indicating the type of error and the card number in error. The user should correct the error and resubmit the job for processing.

- INCREASE THE VALUE OF NRDEV . . . .
  The number of devices configured on the system exceed the number permitted by the program. See subsection 8.4 for action to be taken.

- INCREASE THE VALUE OF NRCHAN . . . .
  The number of channels configured on the system exceed the number permitted by the program. See subsection 8.4 for action to be taken.

- FOR INFORMATION ONLY
  This message will then be followed by several lines of output describing special record types that have been processed, or special processing events that have been executed by the CMDRP. In most cases, the message can be ignored. Those messages that are important, and reveal an error in processing logic, will be described below. All other messages will not be described.

- JULIAN DATES ARE BAD - RUN TERMINATED
  Every GMF data record is preceded by the current Julian date. The CMDRP has found a Julian date that does not agree with the Julian date found on previous records. This can occur when an old GMF data tape is used without degaussing. Old data is on the tape, and if the new data failed to write an end of file mark on the tape because of a system crash or malfunction, the CMDRP, after

reaching the end of the new data, would attempt to process the old data without realizing that is was old. The check on the Julian date prevents this from happening. The CMDRP will terminate cleanly and all reports will be produced.

- HAVE INCREASING OR BAD SEQUENCE NUMBERS . . . .
  or
  BAD TRACE RECORD . . . .
  A problem has occurred in reading the data tape. If the run is reprocessed, the error may disappear. If it reoccurs, then the tape was generated with an error. In most cases, the CMDRP will recover and processing will not be significantly affected.

- PROCESSING TERMINATED BY NXTRECRD . . . .
  CMDRP has requested that the operator mount a new tape and the operator has responded that he did mount the new tape or is unable to mount the new tape. If he has mounted the new tape, CMDRP is unable to match the initial record or the new tape with the last record on the old tape. User should check the data collection procedure to insure that correct tapes were mounted during the data collection phase. CMDRP will terminate cleanly and all reports will be produced.

- . . . . CALL CCTC AT . . . .
  A series of messages may be produced which indicate a severe processing error. If these occur, the output of the run should be considered suspect until further clarification is obtained from CCTC.

8.6 Default Option Alteration

Most users rely upon the standard CMDRP report formats and their default values as these suit a wide range of needs. A capability to change reports is built into CMDRP.

All inputs are free format with the only requirement being that if any value is to be a zero, the user must type the number 0 on the data card. A zero value may not be inputted as a blank. At least one data card is required; that being the word "END" punched on the data card. The "END" card must be the last data card inputted to the program. It is used to signify the end of input, or the fact that there is no input available. In the Channel Monitor, all reports except the Job Conflict Report (subsection 8.5.12), the Special Job Processing Report by Device (subsection 8.5.13) and the Special Job Processing Report Per 10 Minute Report (subsection 8.5.14) are produced unless explicitly turned off. If the Channel Statistics Reports (subsection 8.5.6) are not desired, they may be turned off using the "OFF STANDARD" format. Individual reports cannot be turned on or off and individual histograms also cannot be turned on or off. If the Activity Statistic Report (subsection 8.5.11) is not desired it may be turned off, using the "OFF STATISTICS" format.

8.6.1 Job Device Conflict Report (Action Code QDEV). This option allows the user to produce the Job Device Conflict Report for up to four (4) different devices. If more than four devices are requested, only the first four devices will be analyzed. The first data card contains the word "QDEV". The second data card contains the number of devices to be analyzed. This value cannot exceed 4. The third data card contains a list of unique device IDs, separated by at least one blank. The unique device IDs can be obtained from the Physical Device ID Correlation Report.

8.6.2 Program Debug Options. There are several debug options available to the user, none of which should be selected unless the user is very familiar with the data reduction program. These options produce large amounts of output, useful only when debugging data reduction program/logic errors.

8.6.2.1 Program Number Debug (Action Code DPRG). This will allow debugging for a given program number. Card 1 contains the word "DPRG", and card 2 contains the program number for which debugging is to occur.

8.6.2.2 Device Debug (Action Code DDEV). This will allow debugging for a given unique device ID. Card 1 contains the word "DDEV", and card 2 contains the unique device ID for which debugging is to occur.

8.6.2.3 Queue Location Debug (Action Code DQUE). This option will allow debugging for a given IO queue location. Card 1 contains the word "DQUE", and card 2 contains the IO queue location for which debugging is to occur. The queue location is inputted as a decimal value.

8.6.2.4 Random Access File Debug (Action Code DEBUG). This option will allow debugging to occur whenever the random file containing excess histograms is read or written. One data card containing the word "DEBUG" is all that is required.

8.6.2.5 Channel Debug (Action Code DCHN). This option will allow debugging to occur for a given channel (ACTCHN). This is not input as an actual channel number, but rather as a relative channel number. Card 1 contains the word "DCHN", and card 2 contains the relative channel number for which debugging is to occur.

8.6.3 Removal of Queue Entries (Action Code DELTA). As explained in subsection 8.5.6.7, it is possible for a T22 trace to be generated and never followed by a corresponding T7-Connect Trace. As long as the T22 trace is active, it will be considered as an active I/O request and may effect the queue reports and histograms. If a connect trace has not occurred within a 5-second (default) time span, this T22 trace will automatically be removed from the queue tables and an entry will be made into the Device ID STIOS Not Connected Report. This option allows the user to alter the 5-second default value. Card 1 contains the word "DELTA", and card 2 contains the default time inputted in milliseconds.

8.6.4 Set a Timespan of Measurement (Action Code TIME). The timespan of data collection can cover many hours, of which only a few may be of interest.

This option allows a user to specify the timespan (or spans) to be displayed in all reports. For example, the user may specify that he wants to collect data from 0500 to 2200 and wants to display data only from 0900 to 1700 in all reports. Up to five timespans may be specified, and they must be serially ordered. The format for this action is given in figure 8-24. All times are expressed as four character fields with no intervening blanks. Time is based on a 24-hour clock. If the user wants to request the time 4:07 he must input a "0407." If a start time but no stop time is desired, no characters should be entered after the minutes of the start time. If a stop time is requested, there must be a start time corresponding to it. Individual reports may not be timespanned. The timespans will affect the entire set of output.

8.6.5 Turn a Report On/Off (Action Code ON/OFF). These options allow the user to turn certain report types on or off. The report types effected by these options are the Channel Statistics Reports (subsection 8.5.6) and the Activity Statistics Reports (subsection 8.5.11). These reports are on by default and, therefore, the user should need only to use the OFF option if these reports are not desired. The ON option is supplied only for purposes of completeness. The format for this option consists of the word ON or OFF on card 1 and the word STANDARD or STATISTICS on card 2. The word STANDARD is used to turn off the Channel Statistics Reports and the word STATISTICS is used to turn off the Activity Statistics Reports.

8.6.6 Continue Data Reduction After an Input Option Error (Action Code ERROR). This option allows data reduction to continue when an error has been detected and reported in an input option request. The default value reports the error and aborts the data reduction procedures. The format for this option is the word ERROR on the data card.

8.6.7 W6.4/2H Data Reduction (Action Code RN). This option allows a user to process a GMF data tape (W6.4/2H or W7.2/4JX) under a W6.4/2H software release. It consists of the word RN on a data card.

8.6.8 Record Limitation by Connects (Action Code NCONN). This option allows a user to process only a specific number of connects. This option is especially useful if the tape contains an error on it and cannot be completely processed. Using this option, the user can process the tape or tapes up to the point where the tape error exists. This option requires two data cards. The first data card contains the word NCONN with the second card containing the number of connects to be processed.

8.6.9 Record Limitation by Records (Action Code NREC). This option allows a user to process only a specific number of tape records. This option is especially useful if the tape contains an error on it and cannot be

```
Card  1  A
Card  2  N M
Card  3  B C D E F ...

     where

A = the word TIME
N = the word TOTAL
M = Number of different times appearing on card 3
B,C,D,E,F = Start and stop times used to define timespans.
            Times must be separated by one or more blanks.
```

Figure 8-24. Input Option TIME Format

completely processed. Using this option, the user can process the tape or tapes up to the point where the tape error exists. This option requires two data cards. The first data card contains the word NREC with the second card containing the number of tape records to be processed.

8.6.10 Special Job Processing Reports (Action Code JOB). The Special Job Processing Report described in subsections 8.5.13 and 8.5.14 can be obtained with this option. These reports will not be produced unless this option is invoked. The format consists of three data cards. Card 1 contains the word JOB, card 2 contains the number of special jobs to be reported (not to exceed 5), and card 3 contains the actual SNUMBs, separated by at least one blank column.

8.6.11 Change the Time Quantum Value for the Special Job Processing Report Per 10 Minutes (Action Code RATE). The user can change the time quantum value used to produce the Special Job Processing Report Per 10 Minute by inputting a new time quantum in seconds. Two cards are required. The first card contains the word RATE and the second card contains the new quantum in minutes. The default value is 10 minutes.

8.6.12 END Card (Action Code END). This card must be present at all times and must be the last data card supplied. It consists of the word END typed on the card.

8.7 JCL

The data reduction procedures consist of a single FORTRAN program having a main level and multiple subroutines. A description of the more important JCL cards is presented below (see figure 8-25).

The $ LIMITS card should be changed to meet the user needs. The run time (99) and output limit (30K) may both need to be altered as required by the duration of the monitoring run. The CMDRP requires 48K of memory in order to execute plus an additional 2K for SSA space. During the initial loading process, CMDRP will actually require 60K of memory, but 10K will be released immediately upon loading.

The statement

```
$ DATA I*
```

is used to identify the data cards that follow as described in subsection 8.6. At least one data card is required, that being an "END" request.

8.8 Multireel Processing

If more than a single reel of data has been collected, a series of messages will be outputted to the console informing the operator that a new data reel is required. The following are the messages produced.

```
COL  1      8          16

     $      IDENT      1820251/30/3044
     $      SELECT     B29IDPX0/OBJECT/CM
     $      TAPE       01,X1D,,12345
     $      LIMITS     99,50K,-4K,30K
     $      DATA       I*
     $      Data Cards - at least an "END" card must be present
     $      ENDJOB
```

Figure 8-25. CMDRP JCL

a. DISMOUNT REEL #XXXXX THEN MOUNT REEL NUMBER YYYYY ON ZZZZZ

In this case, XXXXX is the old reel number, YYYYY is the new reel number, and ZZZZZ is the tape drive ID.

If the operator fails to mount the new tape, the above message will be repeated three times, after which the program will terminate, and all reports produced.

b. IS TAPE XXXXX MOUNTED ON DRIVE ID YYYYY (Y/N)

In this case, XXXXX is the tape number being requested for mounting and YYYYY is the tape drive ID.

This message occurs when the data reduction program finds the wrong tape has been mounted (by comparing internally generated tape labels). If the operator answers N, the message in (c) below is produced. If the operator answers Y, the data reduction program will terminate and all reports will be produced. In this case, the data reduction program is unable to process the tape. Even though the operator is mounting the correct tape, the internal label on the new tape does not match that being requested by the old tape. The user should check the data collection session to insure that the operator did not respond with an incorrect tape number during multireel change.

After entering the Y or N, the operator will need to hit the EOM key twice in order for the response to be transmitted.

c. WRONG REEL JUST MOUNTED, DISMOUNT AND MOUNT REEL XXXXX ON ZZZZZ

In this case, XXXXX is the new reel number, and ZZZZZ is the tape drive ID.

d. CAN TAPE XXXXX BE MOUNTED ON DRIVE YYYYY (Y/N)

In this case, XXXXX is the new desired reel and YYYYY is the tape drive ID.

If the operator fails to answer this message it will be repeated until he responds with a "Y" for YES or "N" for NO. If he types in "Y", then message (a) will be repeated. If he types in "N", then the program will be terminated and all reports will be produced.

8.9 Tape Error Aborts

During the course of processing it is possible that the operator will be required to abort the data reduction program due to an irrecoverable tape

error. If such a condition occurs, the operator should abort the job with a "U" abort. This will allow the data reduction program to enter its wrap-up code processing and produce all reports generated prior to the tape error.

SECTION 9. COMMUNICATIONS ANALYSIS MONITOR DATA REDUCTION PROGRAM (CAMDRP).

9.1 Introduction

The Communications Analysis Monitor Data Reduction Program is a FORTRAN program that sequentially processes data the Communications Analysis Monitor collected and wrote on tape. CAMDRP produces a number of reports depicting the usage of terminals, the response being received by terminals and the various DAC subsystems, and a special analysis report on Time Sharing Response. Report descriptions are presented in subsection 9.5.

There are two inputs to the CAMDRP. The first is the data tape produced by the CAM in the General Monitor Collector. The second is a set of report option control cards used to alter the reports in some way other than the standard default. The various user input options and their formats are described in subsection 9.6. The actual reports produced by CMDRP are described in subsection 9.5.

9.2 Data Collection Methodology

The CAM in the General Monitor Collector processes a GMF generated trace type 14 and collects information to monitor the usage of the entire terminal and DAC subsystems. The information collected on the occurrence of the above trace enables the CAMDRP to identify the DAC Subsystem Activity, response time being received by both DAC subsystems and terminals, and the extent to which any terminal is being utilized. The method used for generating the CAM traces is described in subsection 5.2.6 and the formats for the CAM generated records used by the CAMDRP are described in subsection 5.4.7.

9.3 Analytical Methodology

All communications between the H6000 and an online user is controlled by the GCOS module .MDNET (.DNWW in W6.4). This module contains a series of buffers, called mailboxes, that are used to store data passing between the datanet and the H6000. Whenever either machine wants to communicate with the other, information is placed in a mailbox and an interrupt is generated. The Communications Analysis Monitor (CAM) is designed to examine the mailboxes each time they are changed and to generate a GMF trace type 14. The trace type 14 is used by CAMDRP to provide data transfer rates, machine response times and user think times. The data transfer rates are derived from the number of words transferred for each interaction. Machine response time can have multiple definitions. One definition is the amount of time from the transfer of the first character of data by the user (carriage return) to the first response back to the user from the

system. This definition is not precise in that as soon as GCOS recognizes it has received information from the datanet, a receipt acknowledgement is sent back to the datanet. This acknowledgement does not indicate any processing by GCOS; just receipt of the data.

A second definition of response time is the same start time (carriage return) but the stop time is when the user has received his last piece of data before being required to give another response. This definition also is not precise in that the system response is not complete until possibly a full screen of data has been transmitted. This definition also lumps GCOS and subsystem (TSS, TRAX) response together. However, it is felt that this method is a more realistic method of response time calculation, and is the method used by CAMDRP.

User think time is defined by CAM to be the amount of time from the start of data transmission to the user until the receipt of the first character of user response. This includes any datanet delay time (monitored by the datanet monitor) and any user wasted time (coffee break, phone call, etc.). However, this is the best definition available with the type of data captured by the CAM. Figure 9-1 presents a pictorial representation of these definitions.

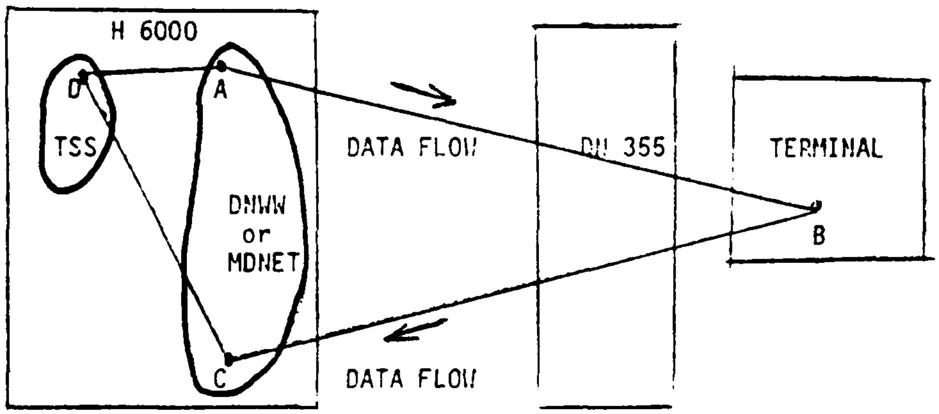
9.4 Data Reduction Methods

The CAMDRP reads only the trace type 14 records and any special records. It ignores lost data records, which can cause loss of some logons and disconnects. The CAMDRP logs a user onto a subsystem only when "connect to slave" command is captured. This command gives the actual subsystem the user is connecting to (TSS, TRAX, etc.). If, when CAMDRP first begins processing, a user is found to already be logged onto the system and no "connect to slave" command has been found, the user is logged onto an "UNKNWN" subsystem. This is because the "connect to slave" command is the only time the actual subsystem name is known.

If, during processing, a datanet is found to have crashed, all users connected to that datanet are disconnected by the CAMDRP and processed as an end terminal session. If a reduction time frame ends, all users are disconnected as if their terminal session ended, and all reports are printed.

9.5 CAMDRP Output

The CAMDRP produces a header page and either a 355 Mailbox Report or Statistical Summary Reports, Terminal Session Reports, and requested histograms. The following subsections will describe all the reports produced by the CAMDRP.



MACHINE RESPONSE TIME
TIME FROM C TO D TO A

USER THINK TIME
TIME FROM A TO B TO C

Figure 9-1. Communications Analysis Concept

9.5.1 Header Page. The header page contains the total number of records read, trace records read, communications analysis (type 14) trace entries read, and the types and number of communication interface commands encountered. The date and time of data analyzed are printed, along with all the data tape numbers processed. An example of the header page is shown in figure 9-2. The version number printed on this report should say 01-82.

9.5.2 Trace Dumps. These reports are produced only when specified by the LIST, ALL, or MAIL input options. These dumps include a 355 Mailbox Trace Dump (Total - option LIST, or Selective - option ALL) and a Terminal Mailbox Dump (option MAIL). These options are described in subsections 9.6.4 and 9.6.8.

9.5.2.1 355 Mailbox Report-Trace Dump. This report is produced only if the user requested input option LIST or ALL. The Mailbox Report provides a formatted listing of the individual communication mailboxes collected by the data acquisition program (CAM). A sample of this output is given in figure 9-3. The report contains a single mailbox per line, separated into 13 fields with column headings for each field appearing at the top of each new page. Column headings and their meanings are as follows:

a. ID - Specifies the unique terminal ID.

b. CMND - Specifies the category of command from one machine to the other. This heading is further explained in the paragraph following this list.

c. OP - Specifies the detailed OP code within a command category requested of the other machine.

d. P - Gives the DN355 processor number. Numbering starts with 0.

e. LINE - Gives the logical line number which is used to reference line tables in the DN355 and H6000.

f. TYPE - Shows the terminal type.

g. TLY - Tally word in H6000 word units. On an output data transfer, it specifies the number of words transferred from the H6000 to the DN355 (four characters per word in DAC mode and six characters per word in remote batch mode). On an input data transfer, it specifies the maximum number of words the H6000 allows the DN355 to transfer.

h. ITLY - Input tally. This specifies the number of words actually input into the H6000 on an input data transfer. It will always be less than or equal to the TLY.

```
COMMUNICATIONS MONITOR VERSION 01-82 FOR NMCC2 ON 122181

                         - SUMMARY OF TRACE ENTRIES READ -
                         # OF RECORDS READ:                       293
                         TOTAL TRACE ENTRIES READ:             119232
                         TOTAL TRACE 14 ENTRIES READ:          119231
                         COMMANDS:
                              RCD          49323
                              RTX          20412
                              WCD            978
                              WTX          48427
                              ACU              0
                              RJM              0
                              RSVP            91
                              ECHO             0

                         MONITOR OVERHEAD - MONITOR    TIME(SEC)    % OVERHEAD

                                            EXEC          600            2
                                            CAM           300            1
                                            TOTAL                        3


                           START TIME(HH:MM:SS.SSS)
                              11:54:  0.000
                           STOP  TIME(HH:MM:SS.SSS)
                              16:03: 34.749
                              FOR A TOTAL OF  4.15 HOURS

               MONITOR TAPE USED - C010
```

Figure 9-2. CAMDRP Header Page

COMMUNICATIONS MONITOR TRACE DUMP FOR NMCC2 ON 122181

ID	CMND	OP	P	LINE	TYPE	TLY	ITLY	SI	CMI	ICM	TOD	RTOD
CY	RCD	ACPDIP	U	00032	VP786W	0	0	00	0	000000	045737764021	22: 6: 0.608
CY	RTX	INPACC	0	00032	VP786W	519	13	00	0	000000	045737765114	22: 6: 0.617
CY	WTX	DACOUT	0	00032	VP786W	5	0	00	0	000000	045737770142	22: 6: 0.641
CY	RCD	SNDOTP	0	00032	VP786W	0	0	00	0	000000	045740060445	22: 6: 1.092
KP	WTX	DACOUT	1	00024	VP7705	21	0	00	0	000000	045740212305	22: 6: 1.811
CY	WTX	DACOUT	0	00032	VP786W	14	0	00	0	000000	045740220154	22: 6: 1.857
UC	RCD	SNDOTP	0	00025	TTY	0	0	00	0	000000	045740411615	22: 6: 2.830
KS	RCD	SNDOTP	1	00036	VP786W	0	0	00	0	000000	045740723005	22: 6: 4.440
CS	RCD	SNDOTP	0	00026	VP7705	0	0	00	0	000000	045740723571	22: 6: 4.445
CS	WTX	DACOUT	0	00026	VP7705	440	0	00	0	000000	045741726256	22: 6: 8.562
KS	WTX	DACOUT	1	00036	VP786W	440	0	00	0	000000	045741726372	22: 6: 8.563
CY	RCD	ACPDIP	0	00032	VP786W	0	0	00	0	000000	045742114324	22: 6: 9.507
CY	RTX	INPACC	0	00032	VP786W	519	25	00	0	000000	045742115447	22: 6: 9.516
RA	RCD	BREAKC	0	00023	RCT	0	0	00	0	000000	045742532522	22: 6: 11.669

Figure 9-3. Mailbox Report

i. ST - Status of the operation.

j. CNT - Count of the number of meaningful characters included in the next field (ICM); a decimal integer.

k. ICM - Intercomputer message field. This is a word in the mailbox for storing extra data to be passed to the other machine. The only information the Communications Monitor looks at in this word is the name of the slave (e.g., TSS) to which a terminal is attempting to connect on a "connect to slave" operation code.

l. TOD - Elapsed time since the system was booted in a 12-digit octal format with 1/64 millisecond resolution.

m. RTOD - Real time-of-day; the wall clock time in the format HH:MM:SS, with one millisecond resolution. It is computed by adding the wall clock starting time (MME GETIME) of the data acquisition program to the elapsed time from the first mailbox to the current mailbox.

The command field specifies the category of request between the two machines. The four most important commands are as follows:

- RCD - READ command data
- WCD - WRITE command data
- RTX - READ text
- WTX - WRITE text.

RCD specifies a request from the DN355 to the H6000, whereas WCD is a request from the H6000 to the DN355. TRX and WTX request actual data transfers with RTX for input and WTX for output.

If a DAC program wants to communicate with a terminal connected to it, the program issues either an "output" request to the system or an "output wait for input" request. When the "output" request (MME GEROUT 03) is issued, the program supplies the data to be sent to the terminal and the program expects notification when the operation is completed. First, a "WTX DACOUT" mailbox will appear at this interface which causes the output message to be transferred from the H6000 to the DN355. After the DN355 transmits the data to the terminal, an "RCD SNDOTP" mailbox appears which informs the H6000 that the output is completed and more output may now be sent. If this program sends more outputs, this mailbox sequence will appear repeatedly.

The mailbox sequence is different when an "output wait for input" (MME GEROUT 04) is issued by the program. The program sends output and waits for the user to enter his input. The program may be swapped out while waiting for the input. First, a "WTX DACOUT" mailbox appears with the same significance as before. No mailbox appears after the output has been completely transmitted to the terminal. Only after the user has entered his line and has depressed the carriage return does an "RCD ACPDIP" mailbox appear at the interface. This action initiates a request for the H6000 to "accept DAC input" from the DN355. The DN355 does not directly transfer the data since it is not known to which address the data should be transferred or even whether the program is in H6000 memory. Once GCOS determines the address to which the data should be transferred (swapping the program in, if necessary), a third mailbox, "RTX INPACC," appears at the interface informing the DN355 that the H6000 will "accept input" and where in the H6000 to move it. This three mailbox sequence is characteristic of the "output wait for input" operation.

In remote batch mode, a continuous stream of either input or output is being transferred. If it is output, the sequence which will be repeated will be "WTX ACCOUT" followed by "RCD SNDOTP." The first mailbox informs the DN355 to transfer batch output from the H6000. The second is the DN355 requesting more output.

On remote batch input, the repetitive sequence is "RCD ACPINP" followed by "RTX INPACC." The first is the DN355 request to the H6000 to accept batch input, and the second is the H6000 accepting it and that the transfer from DN355 to H6000 should be made.

The formatted device names used by both the formatted Mailbox Report and the Statistical Summary Reports correspond to a two-digit octal field appearing in the mailbox. The octal codes and the corresponding device names used in the program are shown in table 9-1.

9.5.2.2 Terminal Mailbox Dump. This report is produced only if the MAIL option is requested along with either the LIST or ALL option. Also, the CAM must have run with the complete communications data option (monitoring of specific terminals). This report gives a dump, in ASCII, Octal, BCD, or all three of all communication traffic between the H6000 and the DN355 for the specific terminals that were monitored. This data will include all SOH (start of header), CR (carriage return), LF (line feeds), etc. For terminals with upper/lower case data, upper case data will be followed by a period (i.e., T.H.E is THE and THE is the). This option allows a user to track exactly what a terminal user is doing. CAUTION - This data may be classified since passwords may be printed. A sample figure is not presented in this document.

Table 9-1. Octal Codes and Device Names for the Mailbox and Statistical Summary Reports (Part 1 of 2)

16	355	Direct DN355 Link
17	XXXX17	Reserved for the System
20	2741	2741 Teletypewriter
21	XXXX21	Reserved for the System
22	XXXX22	Reserved for the System
23	RLP300	Remote Line Printer
24	XXXX24	Reserved
25	MSLINK	Mass Store Link
26	XXXX26	Reserved for the System
27	XXXX27	Reserved for the System
30	MRS200	MRS200 Document Handler
31	DRD200	DRD200 Document Handler
32	DRDDHU	DRD236 or DHJ1604/8/12/16 Document Handler
33-47		Reserved for the System
50-67		Reserved for Test and Diagnostics
61-77		Reserved for Customer Use
01	XXXX01	Reserved for the System
02	XXXX02	Reserved for the System
03	RCT	Remote Computer Terminal
04	TTY	Teleprinter
05	DNET4	DATANET 760 - Screen Size = 4 Lines X 46 Characters

Table 9-1. (Part 2 of 2)

06	DNET8	DATANET 760 - Screen Size = 8 Lines X 46 Characters
07	DNET16	DATANET 760 - Screen Size = 16 Lines X 46 Characters
10	DNET26	DATANET 760 - Screen Size = 26 Lines X 46 Characters
11	VIP775	VIP Series 765/775 - Screen Size = 22 Lines X 92 Characters
	VP786W	VIP Series 786 (WWMCLS) - Screen Size = 22 Lines X 92 Characters
13	VIP 12	VIP Series 7700 - Screen Size = 12 Lines X 80 Characters
14	VIP22	VIP Series 7700 - Screen Size = 22 Lines X 46 Characters
15	VP7705	VIP Series 7700 - Screen Size = 24 Lines X 80 Characters

9.5.3 Statistical Summary Reports. These reports are produced unless the user specifically requests the 355 Mailbox Report. The Statistical Summary Reports include DAC Device and Subsystem Summaries, Remote Batch Device Summary, and Terminal ID Summary.

9.5.3.1 DAC Devices Summary Report. The DAC Device Summary Report (shown in figure 9-4) indicates the activity for each of the different DAC terminal types utilized during the data collection session. The distinctive device types include TTYs, IBM 2741, and several categories of displays (e.g., VIP786W and 7705). Also represented in these reports are devices which use DAC protocols, such as the DN355-DN355 link implemented between the CCTC and ANMCC.

For each DAC device, the following values are reported in terms of mean and standard deviation (where appropriate):

- Number of sessions collected - Number of terminal sessions accumulated in this category.
- Session length (sec) - Time from log-on to log-off
- Input length (char) - Number of characters in an input
- Output length (char) - Number of characters per output
- Number of outputs/output group - Number of distinct outputs in consecutive order (total output length = output length times the number of outputs/output group)
- User think time (sec) - Time from start of last output transfer in output group to end of input transfer
- Machine response time (sec) - Time from end of input transfer to end of that last output transfer
- Inter-output time (sec) - Time from start of previous output transfer to start of succeeding output transfer
- Character rate (char/sec) - Total number of characters transferred, divided by the terminal session length.
- Number of inputs - Total number of user responses during the time period.
- Average number of inputs - Average number of user responses per session (number of inputs/number of sessions collected)
- Number outputs - Total number of system responses during the time period

DAC DEVICE SUMMARY FOR NMCC2 ON 122181

	VP7705		TTY	
	MEAN	STD DEV	MEAN	STD DEV
# SESSIONS COMPLETED	39.		2.	
SESSION LENGTH (SEC)	1044.9	1415.4	2460.0	2037.9
INPUT LENGTH (CHAR)	22.6	53.4	4.4	1.5
OUTPUT LENGTH (CHAR)	245.7	241.7	44.6	13.0
# OUTPUTS PER OUTPUT GROUP	1.9	38.8	1.0	0.2
USER THINK TIME (SEC)	17.8	35.4	6.4	7.5
MACHINE RESPONSE TIME (SEC)	3.2	17.6	0.3	1.1
INTER-OUTPUT TIME (SEC)	1.7	1.4	1.0	0.
CHARACTER RATE (CHAR/SEC)	38.6	39.1	0.5	0.7
# INPUTS	975.0		25.0	
AVG # INPUTS	25.0		12.5	
# OUTPUTS	5392.0		50.0	
AVG # OUTPUTS	138.3		25.0	
FLAG	0		0	

FLAGS:

0 - NORMAL LOG-ON, DATA COLLECTION, TERMINATION.
2 - DUPLICATE ID ENCOUNTERED DURING LOG-ON. OLD ID LOGGED-OFF.
5 - TERMINAL LOGGED-ON VIA SUBROUTINE INSERT. NONSTANDARD PROCEDURE.
THIS FLAG HAS BEEN DELETED FOR NON-BATCH TERMINALS.

Figure 9-4. DAC Device Summary Report

- Average number of outputs - Average number of system responses per session (number of outputs/number of sessions collected

- Flag - Logical flags indicating any unusual conditions in this category. Flag explanations appear on the printout.

The user should note that summaries for the same batch device with different flags are not mixed. Thus, for example, there may be several summaries for RLP 3000 with the majority of normal sessions reflected in one summary and exceptions in the others. The exceptions imply conditions such as GMC starting its collection in the middle of some terminal session for which the session length cannot be determined.

9.5.3.2 DAC Subsystem Summary Report. The DAC Subsystem Summary Report (figure 9-5) summarizes the characteristics of users of DAC subsystems such as TSS and TPS. The heading of each report gives the subsystem utilized. The categories summarized are the same as those categories discussed in subsection 9.5.3.1.

Invariably, a number of the subsystems summarized are bogus due to user typing errors. For example, the following misspellings of TSS may appear: 'YSS', and 'TS'. These reports do not imply that these subsystems exist, only that some user attempted to log-on to a system with that name. All users logged onto the system prior to the CAM starting will be considered as logged onto subsystem UNKNWN.

9.5.3.3 Remote Batch Device Summary Report. The Remote Batch Device Summary Report profiles the devices using remote batch mode communication protocols such as remote line printers (RLP300) and remote computers (RCT) (figure 9-6).

For each device, the following values are reported:

- Number of jobs collected - Total number of distinct jobs reflected in this report.

- Number of input jobs - That part of the total number of jobs which are input jobs.

- Number of output jobs - That part of the total number of jobs which are output jobs. Certain RCT (H716) reports contain jobs that may be counted as both input and output; more detailed examination of the raw data is required to verify this circumstance.

- Job length (sec) - Time from the first to the last data transfer for that job.

DAC SUBSYSTEM SUMMARY FOR NMCC2 ON 122181

	TPE		TSS		UNKNWN	
	MEAN	STD DEV	MEAN	STD DEV	MEAN	STD DEV
# SESSIONS COLLECTED	1.		27.		4.	
SESSION LENGTH (SEC)	104.0	0.	1345.2	1493.2	1003.8	1612.4
INPUT LENGTH (CHAR)	8.0	7.3	23.3	54.5	0.	0.
OUTPUT LENGTH (CHAR)	35.5	62.1	89.5	222.0	438.1	69.6
# OUTPUTS PER OUTPUT GROUP	1.0	0.2	1.0	0.1	610.8	979.0
USER THINK TIME (SEC)	4.6	4.0	18.3	36.0	0.	0.
MACHINE RESPONSE TIME (SEC)	4.0	9.3	3.3	17.9	0.	0.
OUTPUT TIME (SEC)	0.	0.	0.0	0.2	1.7	1.3
CHARACTER RATE (CHAR/SEC)	16.0	0.	11.8	12.0	281.5	325.0
# INPUTS	12.0		934.0		0.	
AVG # INPUTS	12.0		32.6		0.	
# OUTPUTS	42.0		2819.0		2443.0	
AVG # OUTPUTS	42.0		104.4		610.8	

Figure 9-5. DAC Subsystem Summary Report

REMOTE BATCH DEVICE SUMMARY

	RLP300		RLP300		RCT	
	MEAN	STD DEV	MEAN	STD DEV	MEAN	STD DEV
# JOBS COLLECTED	1.		16.		2.	
# INPUT JOBS	0.		0.		2.	
# OUTPUT JOBS	1.		16.		2.	
JOB LENGTH (SEC)	16.0	0.	250.9	281.1	6210.0	2.8
INPUT LENGTH (CHAR)	0.	0.	0.	0.	8.9	58.7
OUTPUT LENGTH (CHAR)	747.4	637.5	1097.5	747.4	11.3	2.7
INPUT CHARACTER RATE (CHAR/SEC)	0.	0.	0.	0.	15.5	6.4
OUTPUT CHARACTER RATE (CHAR/SEC)	327.0	0.	218.4	67.2	0.	0.
FLAG*1*	5		0		5	

1 FLAGS:

0 - NORMAL LOG-ON, DATA COLLECTION, TERMINATION.
2 - DUPLICATE TO ENCOUNTERED DURING LOG-ON. OLD ID LOGGED-OFF.
5 - TERMINAL LOGGED-ON VIA SUBROUTINE INSERT. NONSTANDARD PROCEDURE.

Figure 9-6. Remote Batch Device Summary Report

- Input length (char) - Number of input characters in distinct input.

- Output length (char) - Number of output characters in distinct output.

- Input character rate (char/sec) - Total number of input characters divided by the job length.

- Output character rate (char/sec) - Total number of output characters divided by the job length.

- Flag - Logical flags denoting special conditions. Flag values are explained on the report printout. Reports for the same device, with differing flag values, are maintained separately.

9.5.3.4 Terminal ID Summary Report. The Terminal ID Report (figure 9-7) summarizes the activity on a particular terminal over the entire data collection session. Terminal IDs are unique and unchanging for each terminal configured on a given system. These terminal ID assignments are made by the computer operations personnel and become effective at system boot time. At some sites with multiprocessors, the terminal ID assignments may be different, depending on whether the multiple systems are split. Terminal IDs are two alphanumeric characters which correspond to the 12-bit identification, specified in calls to the system, used to identify the terminal in which communications are directed. Each terminal ID report is headed by this 2-character ID and the device type of that terminal. Items reported are as follows:

- Number of sessions collected - Total number of terminal sessions on that terminal.

- Session (job) length (sec) - Length of terminal session or job.

- Input length (char) - Length of distinct inputs. Also appended is the conversion factor, from words to characters, obtained from the mailbox giving the length in units of H6000 words. DAC uses ASCII characters at four characters per word and remote batch uses BCI characters at six characters per word.

- Output length (char) - Length of distinct outputs.

- Batch input character rate (char/sec) - Total number of input characters in job divided by job length.

- Batch output character rate (char/sec) - Total number of output characters in job divided by job length.

TERMINAL ID SUMMARY FOR NMCC2 ON 122181

	RC	RCT	D7	VP7705	D1	VP7705
	MEAN	STD DEV	MEAN	STD DEV	MEAN	STD DEV
SESSIONS OR JOBS COLLECTED	3.		4.		4.	
SESSION (JOB) LENGTH (SEC)	94.7	65.7	979.8	1478.5	1070.3	1556.2
INPUT LENGTH (CHAR)*1*	93.9	279.7	24.4	39.4	42.9	78.4
OUTPUT LENGTH (CHAR)*1*	3.9	7.6	50.1	80.7	59.0	88.9
BATCH INPUT CHAR RATE (CHAR/SEC)	8.7	11.6	0.	0.	0.	0.
BATCH OUTPUT CHAR RATE (CHAR/SEC)	0.	0.	0.	0.	0.	0.
DAC CHARACTER RATE (CHAR/SEC)	0.	0.	15.5	17.9	13.3	15.3
USER THINK TIME (SEC)	9.0	20.5	22.1	28.3	31.4	52.5
MACHINE RESPONSE TIME (SEC)	0.	0.	2.5	4.4	1.7	2.4
INTER-OUTPUT TIME (SEC)	0.	0.	0.	0.	0.	0.
% TERMINAL USAGE	5.582		77.027		84.1	
# INPUTS	20.0		157.0		128.0	
AVG # INPUTS	6.7		39.3		32.0	
# OUTPUTS	23.0		499.0		378.0	
AVG # OUTPUTS	7.7		124.8		94.5	
FLAG	0		0		0	

1 WORD-TO-CHARACTER CONVERSION DIFFERS FOR DAC AND REMOTE BATCH-
DAC : CHARACTERS = # WORDS * 4 - 2
BATCH CHARACTERS = # WORDS * 6

2 FLAGS:
0 - NORMAL LOG-ON, DATA COLLECTION, TERMINATION.
2 - DUPLICATE ID ENCOUNTERED DURING LOG-ON. OLD ID LOGGED-OFF.
5 - TERMINAL LOGGED-ON VIA SUBROUTINE INSERT. NON-STANDARD PROCEDURE.
THIS FLAG HAS BEEN DELETED FOR NON-BATCH TERMINALS.

Figure 9-7. Terminal ID Summary Report

- DAC character rate (char/sec) - Total number of DAC characters divided by terminal session length.

- User think time (sec) - Time from start of last output transfer in output group to end of input transfer.

- Machine response time (sec) - Time from end of input transfer to end of the last output transfer.

- Inter-output time (sec) - Time from start of previous output transfer to start of succeeding output transfer.

- % terminal usage - The percent of the monitored time this terminal ID was active. Calculated by summing up the total terminal connect time and dividing by the total session length.

- Number inputs - Total number of user responses during the time period

- Average number of inputs - Average number of user responses per session (number of inputs/number of sessions collected)

- Number of outputs - Total number of system responses during the time period

- Average number of outputs - Average number of system responses per session (number of outputs/number sessions collected

- Flag - Logical flags explained in the printout

9.5.4 Delta Time Period Summary Report. This report (figure 9-8) is used to monitor overall communication activity on the system as a function of time. It shows the total number of characters input and output, in DAC and remote batch modes, during consecutive time periods. This report is produced when the time period to be used is specified using the DELTA input option (subsection 9.6.2).

Up to four DN355s can be configured. In multi-DN355 environments, this report can show whether the loads on the two systems are balanced. These reports also show the number of different terminals that were active during each time period.

The times, shown in the left hand column, are 24-hour wall clock times. Interspersed in these reports are messages reflecting the aborting or rebooting of either DN355.

9.5.5 Histogram Reports. These reports are produced only if the user requests them with the HISTG input option (subsection 9.6.3). Three

DELTA TIME PERIOD SUMMARY FOR NMCC2 ON 122181

	DATANET-355 C					
	DIRECT ACCESS			REMOTE BATCH		
TIME	#ACT TRMS	INPUT CHARS	OUTPUT CHARS	#ACT TRMS	INPUT CHARS	OUPUT CHARS
12:27:48	2	58	9070	0	0	0
12:28:18	2	26	9278	0	0	0
12:28:48	2	50	9782	0	0	0
12:29:18	2	14	8786	0	0	0
12:29:48	2	10	8788	0	0	0
12:30:18	1	0	7022	0	0	0
12:30:48	1	0	8788	0	0	0
12:31:18	2	26	10766	0	0	0
12:31:48	2	0	9398	0	0	0
12:32:18	1	0	8788	0	0	0
12:32:48	2	2	7026	0	0	0
12:33:18	2	18	9130	0	0	0
12:33:48	2	86	9106	0	0	0
12:34:18	2	14	10310	0	0	0
12:34:48	2	10	10002	0	0	0

Figure 9-8. Delta Time Period Summary Report

histograms are produced for each requested item. The three histograms are Machine Response Time, User Think Time, and Session Length. These histograms are basically an extension of the previous Statistical Summary Reports. The histograms display the distribution of time values that were measured and used to produce the single number average that is reported in the Summary Reports. The items for which histograms can be produced are subsystems, device types, or terminal IDs. Up to 60 histograms can be produced; i.e., three different histograms for each item requested, with a maximum of 20 items. These 20 items can be distributed in any way among the three categories (subsystems, terminal types, and terminal IDs). Refer to figures 9-9 through 9-11 for sample histograms. A histogram is a pictorial representation which shows the distribution observed for a set of measured values. Figure 9-9 will be used to describe the procedure that should be followed in interpreting these reports. Entries in the column headed SECOND give the range of times which form each histogram bucket. The first bucket is used to report 0 measured values, with all other buckets used to represent a range of values. The entries in the column headed INDIV. NUMBER give the number of responses that were measured that fell within the time range specified by the SECOND column. In figure 9-9, we observe that 2421 responses measured 0 seconds in duration. Since the histogram is displaying integer values, any response that was less than 1 second would be reported as a 0 second response. It will also be observed that 69 responses fell in the range of 16-18 seconds.

Similarly, the columns headed INDIV. PRC and CUMUL. PRC give the individual and cumulative percentages of all responses which were made within each time range. In figure 9-9, we observe that 31% of all responses were 0 seconds in duration, while 9% were between 16-18 seconds. At the same time, it can be observed (CUMUL. PRC) that 94.5% of all responses were measured at 12 seconds or less and that 97.1% of all responses occurred in 21 seconds or less. The graphic portion of the display gives a visual indication of the percentage of responses which were measured for each set of time ranges.

The bottom of the report provides a statistical summary of the data in the report. Statistics given include average, variance, and standard deviation. These statistics apply to all data points that were measured. The statistics concerning OUT OF RANGE are for those data points which fall outside the range of the histogram (i.e., are larger than the bucket range of the last bucket displayed under the column headed SECOND). OUT OF RANGE points are included in the previous statistics.

9.5.6 Response Time Limit Report. This report is produced only if the user requests it with the RESP input option (subsection 9.6.6). This report will print out a line of information every time a terminal

```
                    DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:54:15 ON 81-12-21

                          MACHINE RESPONSE TIME FOR SUBSYSTEM   TSS

INDIV.  CUMUL.  CUMUL.   INDIV.                       PERCENT OF OCCURRENCE                     REPORT
NUMBER  NUMBER   PRC      PRC    SECOND    00   05   10   15   20   25   30   35   40   45   50      1
                                           I....I....I....I....I....I....I....I....I....I....I
2421     2421   31.00    31.00    0-    0  Ixxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
3531     5952   76.20    45.20    0-    3  Ixxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
 945     6897   88.30    12.10    4-    6  Ixxxxxxxxxxxx
 331     7228   92.50     4.20    7-    9  Ixxxx
 156     7384   94.50     2.00   10-   12  Ixx
  85     7469   95.60     1.10   13-   15  Ix
  69     7536   96.50     0.90   16-   18  Ix
  47     7585   97.10     0.60   19-   21  Ix
  46     7631   97.70     0.60   22-   24  Ix
  27     7658   98.00     0.30   25-   27  I
   .       .      .        .       .     .  .
   .       .      .        .       .     .  .
   .       .      .        .       .     .  .

7810 ENTRIES TOTAL    AVERAGE =    4.12228       VARIANCE =    335.431    STANDARD DEVIATION =    18.315
        190 (2%) OUT OF RANGE      AVERAGE FOR THESE =     286.95         IN RANGE AVERAGE =      3.43
```

Figure 9-9. Machine Response Time Report

```
                    DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:54:15 ON 81-12-21

                              USER THINK TIME FOR SUBSYSTEM    TSS

INDIV.   CUMUL.   CUMUL.   INDIV.                       PERCENT OF OCCURRENCE                    REPORT
NUMBER   NUMBER    PRC      PRC     SECOND     00  10  20  30  40  50  60  70  80  90  100     2
                                               I....I....I....I....I....I....I....I....I....I....I
   8         8     0.10     0.10     0-    0   I
5568      5576    70.40    70.30     0-   10   Ixxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
1166      6742    85.10    14.70    11-   20   Ixxxxxxx
 466      7208    91.00     5.90    21-   30   Ixxx
 230      7438    93.90     2.90    31-   40   Ix
 140      7578    95.70     1.80    41-   50   Ix
  90      7668    96.80     1.10    51-   60   Ix
  53      7721    97.50     0.70    61-   70   I
   .         .       .        .      .     .   .
   .         .       .        .      .     .   .
   .         .       .        .      .     .   .

7919 ENTRIES TOTAL     AVERAGE =     12.64251     VARIANCE =      619.687     STANDARD DEVIATION =     24.694
        1( 0%) OUT OF RANGE          AVERAGE FOR THESE =      497.00     IN RANGE AVERAGE =      12.58
```

Figure 9-10. User Think Time Report

```
                DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:54:15 ON 81-12-21

                          SESSION LENGTHS FOR SUBSYSTEM      TSS

INDIV.    CUMUL.    CUMUL.    INDIV.                      PERCENT OF OCCURRENCE                         REPORT
NUMBER    NUMBER     PRC       PRC    MINUTE      00   05   10   15   20   25   30   35   40   45   50    3
                                                  I....I....I....I....I....I....I....I....I....I....I
  15        15      10.60     10.60    0-    0    Ixxxxxxxxxxx
  43        58      40.90     30.30    0-    5    Ixxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
  14        72      50.80      9.90    6-   10    Ixxxxxxxxxx
  16        88      62.10     11.30   11-   15    Ixxxxxxxxxxx
   8        96      67.70      5.60   16-   20    Ixxxxxx
  14       110      77.60      9.90   21-   25    Ixxxxxxxxxx
   .         .        .         .      .     .    .
   .         .        .         .      .     .    .
   .         .        .         .      .     .    .

142 ENTRIES TOTAL       AVERAGE =     17.33099     VARIANCE =     433.799     STANDARD DEVIATION =     20.828
```

Figure 9-11. Session Length Report

experiences a response time greater than or equal to the requested limit. The information printed includes Terminal ID, subsystem name, response time in seconds, and time of day. Refer to figure 9-12.

9.5.7 User Think Time Limit Report. This report is produced only if the user requests it with the THINK input option (subsection 9.6.7). This report will print out a line of information every time a terminal experiences a response time greater than or equal to the requested limit. The information printed includes Terminal ID, subsystem name, think time in seconds, and time of day. Refer to figure 9-12.

9.5.8 Terminal Session and High Terminal Usage Reports. The Terminal Session Report (figure 9-13) is produced whenever the Statistical Summary Reports are requested. The report gives an account of every session that occurs during the monitoring session. Every time a user logs off or is logged off due to a DN355 abort, TCALL, or monitor termination, an entry into this report is produced. The report gives the Log On Time, Log Off Time, Terminal ID, Subsystem, Session Length, Response Time, # Inputs, # Outputs. If a terminal was logged onto a subsystem when CAM started, then there is no way for CAM to determine the subsystem being used by the terminal. In this case, the subsystem will be reported as UNKNWN. If a user logs onto a subsystem and then JDAC's to a different subsystem, CAM is unable to determine this switch. The entire user session will be reported as being on the subsystem originally logged onto. The Session Length is given in seconds. The Response Time is given in seconds and is the average response time over the session. The # Inputs is the number of input requests sent by the user. The # Outputs is the number of output response groups sent to the user. This report can help pinpoint excessive response times. It can also be used to determine if a terminal is logged onto the system and is not being used (low inputs, high or low outputs, long session length).

The High Terminal Usage Report is included as part of the Terminal Session Report and provides a list of terminals that have been logged on for a specified percent (default 75%) of the session. This will list terminals by ID and type, give the percent of time the terminal was logged on and the number of sessions during this time. (See figure 9-14.)

9.5.9 Opcode Count Report. This report (figure 9-15) is produced whenever the System Summary Reports are produced. This report gives a listing of all the opcodes that were transmitted between the H6000 and the DN355, and a count of how many of each opcode there were. This report is of interest mainly when the following opcodes appear:

```
EXCESS THINK/RESPONSE TIME REPORT FOR NMCC2 ON 122181

TERMINAL  C6  ON  SUBSYSTEM  TSS   HAD A THINK TIME OF  208 SECS AT 16:35:55
TERMINAL  CI ON   SUBSYSTEM  TSS   HAD A THINK TIME OF  120 SECS AT 16:48:21
TERMINAL  BT ON   SUBSYSTEM  TSS   HAD A THINK TIME OF  223 SECS AT 16:48:57
TERMINAL  BD ON   SUBSYSTEM  TSS   HAD A THINK TIME OF  197 SECS AT 16:49:11
TERMINAL  BT ON   SUBSYSTEM  TSS   HAD A RESPONSE TIME OF  50 SECS AT 16:43:54
```

Figure 9-12. Response Time/User Think Time Limit Report

TERMINAL SESSION REPORT FOR NMCC2 ON 122181

LOG ON TIME	LOG OFF TIME	TERMINAL ID	SUBSYSTEM	SESSION LENGTH	RESPONSE TIME	# INPUTS	# OUTPUTS
11:59:30	12:01:14	AK	TSS	104 SEC	1.111 SEC	10	18
11:54:31	12:04:01	A2	UNKNWN	571 SEC	3.811 SEC	38	309
12:04:20	12:04:42	CN	TSS	22 SEC	1.000 SEC	1	3
12:06:51	12:07:20	A2	TSS	29 SEC	1.000 SEC	1	3
12:03:20	12:12:36	AK	TSS	556 SEC	6.700 SEC	21	60
12:07:25	12:14:21	A2	TSS	416 SEC	10.474 SEC	19	168
11:54:40	12:18:34	A7	UNKNWN	1434 SEC	2.269 SEC	54	263
12:18:18	12:18:48	A2	TSS	29 SEC	0. SEC	1	2
12:18:26	12:21:43	CL	TSS	197 SEC	2.000 SEC	24	88
12:23:50	12:23:57	AE	UNKNWN	8 SEC	0. SEC	0	0
12:25:27	12:25:33	AB	TSS	5 SEC	0. SEC	0	1
12:26:06	12:28:38	AJ	TSS	152 SEC	1.625 SEC	9	24
12:26:51	12:28:46	AT	TSS	115 SEC	3.000 SEC	11	19

Figure 9-13. Terminal Session Report

HIGH TERMINAL USAGE REPORT FOR NMCC2 ON 122181

TERMINAL ID	TERMINAL TYPE	PERCENT UTILIZATION	NUMBER SESSIONS
AE	TTY	90.2	8.0
02	XXXX24	97.5	5.0
01	XXXX24	97.5	5.0
A8	VP7705	100.0	1.0

Figure 9-14. High Terminal Usage Report

OPCODES COUNT FOR NMCC2 ON 122181 AT 16:03: 34.749

TERMINAL ACCEPTED	164	DISCONNECT THIS LINE	117
DISCONNECT ALL LINES	2	ACCEPT CALLS	4
INPUT ACCEPTED	20412	ACCEPT OUTPUT	242
ACCEPT FINAL OUTPUT	12	OUTPUT NOT AVAILABLE	1
ACCEPT DIRECT OUTPUT	27614	ACCEPT DIRECT OUTPUT-INPUT	20501
REJECT REQUEST-TEMP	49	TERMINAL REJECTED	392
DISCONNECT ACK	26	6000 INITIALIZED	4
BREAK ACKNOWLEDGED	219	TERMINAL CHARACTERISTICS CHANGE	58
ACCEPT NEW TERMINAL	556	DISCONNECT LINE	26
SEND INITIAL OUTPUT	2	SEND OUTPUT	27841
CONNECT TO SLAVE	160	ACCEPT DIRECT INPUT	20461
BREAK	219	TERMINAL CHARACTERISTICS CHANGE ACK	58

***** END REACHED *****

Figure 9-15. Opcode Count Report

OPCODE	DESCRIPTION
11	Output not available
16	Reject request (temporary)
17	Reject request (permanent)
20	Terminal rejected
110	Backspace output

These opcodes indicate a delay in data transmission or a communications problem. If these opcodes show up consistently, and in significant numbers, a detailed analysis should be conducted.

9.5.10 <u>Response Time Report</u>. This report is produced whenever the user sets the interval time using the input option RATE (subsection 9.6.11). The report shows, for each interval, the time of day, the response time in general (i.e., averaged overall DAC subsystems), and the response time for TimeSharing. (See figure 9-16).

9.5.11 <u>Error Messages.</u> The CAMDRP can produce multiple error messages relating to the data type. Most of these messages are actually warning messages, which the CAMDRP will try to recover from and will continue to process.

The most prevalant error message is the warning message "TERMINAL ID NOT FOUND." This message usually occurs when a terminal has been logged onto the system prior to the CAM starting to collect its data. When the CAMDRP tries to find a particular user who is receiving or transmitting data in its tables, that user will not be found since the CAMDRP did not find any log-on record for him. The user is logged onto the system and the CAMDRP continues processing.

The main reason for the CAMDRP to abnormally stop processing is the error message "NO MORE ROOM IN INDEX ARRAY." This means that an internal array has been filled. This is usually the terminal ID array. The parameter SMAX must be increased to enlarge the required arrays. The current size of SMAX is 100. This can be exceeded if there are a large number of users on the system when the CAM is started. If a terminal is logged on when the CAM is started, the terminal is logged on to subsystem UNKNWN. When this terminal disconnects and reconnects, it is now logged on to a valid subsystem and a different entry is made as this is now a complete terminal session. All complete terminal sessions are collected in one entry, but any unusual session required a separate entry. All other messages produced will be self-explanatory. If they do not indicate a severe error, the words "For Information only" will appear with the message.

RESPONSE TIME REPORT FOR DNAH66 ON 121781

TOD	OVERALL	TSS
10:06:31	2 SEC	1 SEC
10:11:36	1 SEC	1 SEC
10:16:36	1 SEC	1 SEC
10:21:41	4 SEC	4 SEC
10:26:46	1 SEC	1 SEC
10:31:52	1 SEC	1 SEC
10:36:52	1 SEC	1 SEC
10:41:57	2 SEC	2 SEC
10:47:01	8 SEC	8 SEC
10:52:06	2 SEC	2 SEC
10:57:06	1 SEC	1 SFC
11:02:25	1 SEC	1 SEC
11:07:31	14 SEC	14 SEC
11:12:36	1 SEC	1 SEC
11:17:36	1 SEC	1 SEC
11:23:20	1 SEC	1 SEC

Figure 9-16. Response Time Report

9.6 Default Option Alteration

The Communication Analysis Monitor Data Reduction Program (CAMDRP) uses the trace tape generated by the GMC and user data cards as input. The user has several optional inputs. These options include Timeframe Reduction, Delta Timeframe, Histogram, Trace Dump, User Think Time Limit, Machine Response Time Limit, Record Count Limitation, Terminal Busy Limit, Response Time Report time frame, and Terminal Mailbox Dump. These options are evoked by specifying an input option (action code) and any other required inputs specified in the following subsections. Default options are given in subsection 9.6.13.

All inputs are free format with the only requirement being that if any value is to be a zero, the user must type the number 0 on the data card. A zero value may not be inputted as a blank. In addition, at least one data card with the word END specified is required.

9.6.1 Timeframe Reduction Report (Action Code TIME). This option allows the user to specify up to five different consecutive processing timeframes. For example, the user may collect data from 0500 to 2200 hours and specify that he wants to process only 1900 to 2000 hours and 2100 to 2200 hours. The timespans set through this option apply to all report processing.

Up to five timespans may be specified and they must be chronologically ordered. In specifying time spans, a start time and a stop time must be supplied. If a start time is specified, but no stop time is specified, there should be no data on the card after the start time is specified. All times are expressed as S1M1 where S1 is an hour and M1 is a minute. All times are considered to be on a 24-hour clock, and must be expressed as 4-digit fields with no intervening blanks. If the user wants to request the time 4:07 he must input a "0407." Figure 9-17 has the card formats and an example.

9.6.2 Delta Timeframe Report (Action Code DELTA). This option allows the user to produce a report (subsection 9.5.4) for each DATANET-355 giving the number of active terminals, input characters, and output characters every X seconds where X is a user-specified value. The first data card contains the option name "DELTA". The second data card contains the length of the delta timeframe in seconds followed by the word COMPRESS or NO. This word should be separated from the time by at least one intervening blank. The word COMPRESS is included if the user wants to suppress the printing of lines with all zeros for data (i.e., no activity during this timeframe), or the word NO is included if the user wants blanks or zero lines printed.

```
CARD   1   TIME
CARD   2   N
CARD   3   H1M1     H2M2     H3M3     ....H10M10
```

Where

```
N = Number of different times appearing on card 3
H1M1 =     Time used to define a timespan.
           Individual times must be separated from
           each other by at least 1 blank column.
           (see section 9.6.1)
```

Figure 9-17. Card Format - Input Option TIME

9.6.3 Histogram Report (Action Code HISTG). This option allows the user to get up to 20 groups of histograms (subsection 9.5.5). Each group includes a histogram for machine response time in seconds, user think time in seconds, and session length time in minutes.

These histograms can be produced by subsystem, device types, or terminal ID. The user is allowed any combination of these three categories, with a maximum of 20 total items. The input option name HISTG is used for these histograms. The second data card contains the number of subsystems wanted, number of device types wanted, and number of terminal IDs wanted.

The next card(s) contains the subsystem names, if requested. The following card(s) contains the device types, if requested. (See table 9-2 for a list of acceptable device type names.) The next card contains up to 20 two-character terminal IDs. The format of these cards is shown in figure 9-18.

9.6.4 Trace Dump Report (Action Code LIST or ALL). These options allow the user to get a formatted dump of all CAMDRP traces. The input option name for the Trace Dump Report (subsection 9.5.2) is LIST. The input option name for both Trace and Summary Report data (subsection 9.5.2) is ALL. If the user wishes to limit the amount of output, an option exists to print out only certain subsystems, terminal IDs, or terminal types. This is accomplished by using the HISTG input option with the LIST input option. In this case, no histograms will be produced and the trace dump will be limited to the requested terminals, subsystems, and terminal types. This option consists of a single data card containing the word LIST or ALL.

9.6.5 Record Count Limitation (Action Code NREC). This option permits the user to process only a certain number of tape records. The input option name for the Record Count Limitation is NREC. The second data card contains the number of tape records to be read.

9.6.6 Response Time Limit (Action Code RESP). This option permits the user to specify an acceptable machine response time in seconds. If any terminal exceeds or equals this limit, the terminal ID and response time are printed out (subsection 9.5.6). The format of this option is the word RESP on the first data card and the response time limit on the second data card.

9.6.7 Think Time Limit (Action Code THINK). This option permits the user to specify an acceptable User Think Time in seconds. If any user exceeds or equals this limit, the terminal ID and think time are printed out (subsection 9.5.7). The format of this option is the word THINK on the first data card and the think time limit on the second data card.

Table 9-2. Acceptable Device Type Names

DEVICE TYPE	CAMDRP INPUT
Remote Computer	RCT
Teletype	TTY
VIP 775	VIP775
VIP 786W	VP786W
VIP 12	VIP12
VIP 22	VIP22
VIP 7705	VP7705
2741	2741
RLP 300	RLP300
Mass Store Link	MSLINK
MRS 200 Document Handler	MRS200
DRD 200 Document Handler	DRD200

```
CARD   1   HISTG
CARD   2   B   C   D
CARD   3   E   F   G...
CARD   4   H   I   J...
CARD   5   K   L   M...
```

Where

B = Number of subsystems wanted
C = Number of device types wanted
D = Number of terminal IDs wanted
E,F,G = Up to 10 subsystem names separated by at least one blank (may go to more than 1 card)

H,I,J = Up to 10 device types separated by at least one blank (may go to more than 1 card)
K,L,M = Up to 20 terminal IDs separated by at least one blank

Figure 9-18. Histogram Reports, Input Option HISTG

9.6.8 Terminal Mailbox Dump (Action Code MAIL). This option allows the user to get a dump of the terminal traffic collected for the specified terminal IDs. (Reference subsection 9.5.2.2) This output can be in ASCII, BCD, OCTAL, or all three. See figure 9-19 for the format of this option. NOTE - this option will turn on the LIST option.

9.6.9 Terminal Busy Limit (Action Code BUSY). This option allows the user to change the threshold for the High Terminal Usage Report (subsection 9.5.8). Whenever a terminal is connected to the system for greater than the desired limit, the terminal ID will be printed. Two cards are required for this option. The first card has the word BUSY on it and the second card contains a % busy limit value.

9.6.10 W6.4/2H Data Reduction (Action Code RN). This option allows the user to process a GMF data tape (W6.4/2H or W7.2/4Jx) under a W6.4/2H software release. It consists of the letters RN on a data card.

9.6.11 Response Time Report Time Frame (Action Code RATE). This option allows the user to produce a report (subsection 9.5.10) giving the average response time over a time interval for both TimeSharing and all subsystems combined. This option requires two data cards. The first card contains the word RATE and the second card contains the number of minutes between response time printouts.

9.6.12 Terminate Input Options (Action Code END). This option is required as the last input option data card. It may be the only data card if standard default options are selected. It consists of the word END on a data card.

9.6.13 Default Options. The default options for the variable input are as follows:

ACTION CODE	Option	Default Value
TIME	Timeframes	None, total tape processed.
DELTA	Delta Time-frames	None, this report is not processed. If Delta time is given but not the word COMPRESS, all data are printed.
HISTG	Histograms	None, no histograms produced.
LIST	Trace	None, report data reduction is done, not trace dump.

```
CARD   1   MAIL
CARD   2   N
CARD   3   B   C   D

           Where

N = Number of terminals to be dumped (1 or 2)
B = The letters BCD for a BCD dump
    The letters ASCII for an ASCII dump
    The letters OCTAL for an OCTAL dump
    The letters ALL for all three dumps
C = Terminal ID #1
D = Terminal ID #2 (present only if N=2)
```

Figure 9-19. Terminal Mailbox Dump, Input Option MAIL

NREC	Record Count Limit	None, total tape processed
RESP	Response Time Limit	9999 seconds
THINK	User Think Time Limit	9999 seconds
MAIL	Terminal Mailbox Dump	None, no mailbox dump is produced. Only valid with specially collected data tapes.
BUSY	Terminal Busy	75%
RN	Process on WW6.4	Assumed CAMDRP will be executed under a WW7.2/4JS system
RATE	Response Report Time Frame	9999 minutes (no reports printed)

9.7. JCL

Following is a sample of the JCL required to run CAMDRP. The only change required involves the use of input data. CAMDRP requires 50K of memory to process, but will use 65K during the load procedure. Immediately upon loading, the additional 15K will be released.

```
$ IDENT      User Accounting Information

$ USERID     User Identification/Password/Classification

$ SELECT     B29IDPXO/OBJECT/CAM

$ LIMITS     999,50K,-4K,15K

$ TAPE       01,X1D,,Tape #

$ DATA       I*

  DATA cards

  (at least an "END" card must be present)
```

9.8. Multireel Processing

If more than a single reel of data has been collected, a series of messages will be outputted to the console

informing the operator that a new data reel is required. The following are the messages produced.

a. DISMOUNT REEL #XXXXX THEN MOUNT REEL NUMBER YYYYY ON ZZZZZ

In this case, XXXXX is the old reel number, YYYYY is the new reel number, and ZZZZZ is the tape drive ID.

If the operator fails to mount the new tape, the above message will be repeated three times, after which the program will terminate, and all reports produced.

b. IS TAPE XXXXX MOUNTED ON DRIVE ID YYYYY (Y/N)

In this case, XXXXX is the tape number being requested for mounting and YYYYY is the tape drive ID.

This message occurs when the data reduction program finds the wrong tape has been mounted (by comparing internally generated tape labels). If the operator answers N, the message in (c) below is produced. If the operator answers Y, the data reduction program will terminate and all reports will be produced. In this case, the data reduction program is unable to process the tape. Even though the operator is mounting the correct tape, the internal label on the new tape does not match that being requested by the old tape. The user should check the data collection session to insure that the operator did not respond with an incorrect tape number during multireel change.

After entering the Y or N, the operator will need to hit the EOM key twice in order for the response to be transmitted.

c. WRONG REEL JUST MOUNTED, DISMOUNT AND MOUNT REEL XXXXX ON ZZZZZ

In this case, XXXXX is the new reel number, and ZZZZZ is the tape drive ID.

d. CAN TAPE XXXXX BE MOUNTED ON DRIVE YYYYY (Y/N)

In this case, XXXXX is the new desired reel and YYYYY is the tape drive ID.

If the operator fails to answer this message it will be repeated until he responds with a "Y" for YES or "N" for NO. If he types in "Y", then message (a) will be repeated. If the types in "N", then the program will be terminated and all reports will be produced.

9.9 Tape Error Aborts

During the course of processing it is possible that the operator will be required to abort the data reduction program due to an irrecoverable tape error. If such a condition occurs, the operator should abort the job with a "U" abort. This will allow the data reduction program to enter its wrap-up code processing and produce all reports generated prior to the tape error.

SECTION 10. DATANET-355 DATA REDUCTION PROGRAM (DDRP).

10.1 Introduction

The DATANET-355 Data Reduction Program (DDRP) is a FORTRAN program that sequentially processes data the DATANET-355 GRTS Monitor collected and wrote on tape. DDRP produces a number of reports describing the performance of the DATANET-355 front ends. CPU and resource usage, subchannel usage, and user response times are but some of the many reports that can be obtained. Report descriptions are presented in subsection 10.5.

There are two inputs to the DDRP. The first is the data tape produced by the GRTM in the General Monitor Collector. The second is a set of report option control cards used to alter the reports in some way other than the standard default. The various user input options and their formats are described in subsection 10.6. The actual reports produced by DDRP are described in subsection 10.5.

10.2 Data Collection Methodology

The GRTM in the General Monitor Collector processes a GMF generated trace (type 62) and collects information to monitor the performance of the DATANET-355 front ends. The performance information is collected within the DATANET-355 and transmitted from the DATANET to the GMF which is resident in the H6000. Under normal operating conditions, the DATANET-355 does not generate performance data. In order to generate the desired performance data, it is necessary to alter the standard DATANET-355 GRT software. The method for altering the GRT software is described in subsection 5.2.7.3. The alters which must be applied to the GRT software not only allow the DATANET-355 to generate performance data, but also provide the mechanism by which the DATANET-355 communicates with the GMF. This communication process is described in subsections 5.2.7.4 and 5.2.7.5. The format for the GRTM generated records used by the DDRP are described in subsection 5.4.8.

10.3 Analytical Methodology

Within the GRTS-II Monitor, a series of 10 different events are captured and the time of their occurrence is recorded. The 10 different events are as follows:

1. Connect time of a terminal.

2. DN355 requesting output from the H6000.

3. H6000 telling the DN355 to accept direct output.

4. H6000 telling the DN355 to accept direct output and return input.

5. DN355 telling the H6000 to accept input.

6. H6000 telling DN355 that it accepted the input.

7. Disconnect time of a terminal.

8. DN355 has received output from the H6000.

9. DN355 has begun to transmit data to a terminal.

10. DN355 has completed transmission of data to a terminal.

Using the above events, seven different response times are defined and reported at the DATANET level and for specified terminals. These seven different response times are as follows:

1. H6000 Data Acceptance Time From the DATANET (Event 6 - Event 5)

2. DATANET Acceptance Time From the H6000 (Event 8 - Event 3 or 4)

3. DATANET Processing Time (Event 9 - Event 8)

4. DATANET Transmission Time (Event 10 - Event 9)

5. User Processing Time + DATANET Input Time (Event 5 - Event 10)

6. Machine Response Time (Event 3 or 4 - Event 6 or 2)

7. System Response Time (Event 4 - Event 6)

Machine Response Time is calculated as the sum of the individual H6000 responses. As an example, when a user lists a large file on a VIP, the H6000 will transmit several lines at a time to the DATANET-355. When the screen is full, the H6000 requests input from the user (i.e., clear screen) so the H6000 knows when to continue transmitting data. The sum of the transmission times of each of the segments, up to the request for input, is considered machine response time. A sample trace sequence by event number would be:

a. Event #5 (DATANET-355 asking H6000 to list file)

b. Event #6 (H6000 has received request)

c. Event #3 (H6000 sending four or five lines back to DATANET)

d. Event #8 (DATANET-355 has received output)

e. Event #9 (Transmission to terminal begun)

f. Event #10 (Transmission to terminal completed)

g. Event #2 (DATANET requesting more output from H6000)

h. Event #3 (H6000 sending additional lines of the file)

i. Event #8 (as before)

j. Event #9 (as before)

k. Event #10 (as before)

l. Event #2 (DATANET requesting more output from H6000)

m. Event #4 (H6000 has now completed sending one screen full of data and is requesting input from user; i.e., clear screen, break, etc.)

Machine Response = (c-b) + (h-g) + (m-l)

System response is calculated as the total elapsed time from user input to request for more user input. In the above example, this would be (m-b).

10.4 Data Reduction Methods

The DATANET-355 Data Reduction Program outputs consist of histograms, serial plots, and tabular reports. These outputs have a number of parameters which can be modified by card input at run time. Most reports may be turned on or off, and a set of timespans may be specified for measurement. These options are completed described in subsection 10.6. The method for altering histograms and plots require an understanding of the internal parameters that control these outputs. These parameters will be described in this subsection.

The user has the option of obtaining a set of eight histograms describing the response being obtained during various phases of processing. These histograms will be described in subsection 10.5.3. These histograms are normally not produced and must be requested for specific DATANETs and/or terminals. The method for requesting histograms will be described in subsection 10.6.1 and 10.6.20. A set of eight histograms will be produced for each requested DATANET and/or terminal. The definitions of these response times are given in subsections 5.2.7.7.3, 5.4.8, and 10.3 of this document.

There are two characteristics for each histogram directly available to the user. The first of these characteristics is the lowest value, stored in the LOW array. Any input received by this histogram that is

less than this value will be entered into the first histogram cell along with all entries that fall within the range of that cell. For all eight histograms, this array defaults to zero. There is an input action which allows the user to modify this array for any of the eight histograms (see subsection 10.6.20).

The second characteristic is the range or width of each cell. It is determined by the INTEV array. Once again, there is a user action which allows the user to modify this array for any of the eight histograms. The default values are (5,2,2,1,10,2,2,1) respectively.

The size of the histogram is determined from the internal parameter MXTBSZ which specifies how many cells or "buckets" are contained in the histogram. It indirectly specifies the upper value which could fall within the display range of the histogram. If an entry is made above this range, it is placed in an out-of-range cell of the histogram. The number of the out-of-range occurrences is printed with the histogram, along with their average value, so that the histogram can be altered to handle the variability of the range properly. If an increase beyond this is desired, MXTBSZ must be increased causing an increase in the memory size of the data reduction program. This must be done via an edit of the source code, ensuring that all values of MXTBSZ are changed. The current value of MXTBSZ is 50.

There are three characteristics directly available to the user for each individual plot used. The actual plot formats and information that is plotted will be described in subsection 10.5.2. The first characteristic, MAXNUM, is the maximum absolute length of the abcissa (print lines) to be plotted. The second and third characteristics, YMAX and YMIN, define the upper and lower limits of the horizontal ordinate. These two values, along with the width of the print page, determine the value of one increment, along the horizontal axis (referred to as DELTA on the plot). The actual formulas used are:

DELTA = INTEGER ((YMAX - YMIN)/126 + .5)
YMAX = DELTA* 126 + YMIN

Figure 10-1 shows the default values for the plots. Subsection 10.6.2 describes how plot parameters may be altered.

10.5 DDRP Output

The DDRP outputs consist of histograms, serial plots, and tabular reports. Table 10-1 lists all reports available to the user by default or by input request. The input requests will be described in subsection 10.6 and the actual reports will be described in this subsection. The reports of the DATANET Reduction Program can be used to study the following for each active DATANET:

Plot #	Max Lines In Plot	Y-Axis Max	Y-Axis Min
1	No limit	500	0
2	No limit	3000	0
3	No limit	30000	500
4	No limit	50000	15000
5	No limit	100	0
6	No limit	100	0
7	No limit	10000	0
8	No limit	150	0
9	No limit	100	0

Figure 10-1. Default Values For Plots

Table 10-1. DATANET-355 Reports (Part 1 of 3)

Tabular Reports Generated by Default

Report ID/ File Code	Description
RESPD/21	Average Response Time For All Users by DATANET
BUFF/21	HSLA/Subchannel Transmission Report by DATANET
RESPL/28	Average Response Time For Specifically Designated Line IDs
HSLA/21	HSLA Subchannels Being Monitored
CARD/21	Card Images from I* of the GMF Monitor (always generated)
-/23	List of Active Line IDs (always generated)
THRESH/20	HSLA Threshold Report (default = 9999999)
-/42	Response Interval Unmatched Pairs Verification (always generated when DATANET reports are produced)
-/42	Response Reject Messages

Tabular Reports Generated By Request

MATCH/20	Response Interval Matched Pairs Verification
TRACE/22	Annotated List of the DATANET Trace

Table 10-1. (Part 2 of 3)

Histogram Reports Generated by Request
For a DATANET or Special Line ID

Report ID/ File Code	Description
HISTG1/21	H6000 Data Acceptance Time From Requested Device
HISTG2/21	Data Acceptance Time For Requested Device From H6000
HISTG3/21	Processing Time For Requested Device
HISTG4/21	Transmission Time For Requested Device
HISTG5/21	User Processing + Data Input Time For Requested Device
HISTG6/21	H6000 Machine Response Time For Requested Device
HISTG7/21	System Response/User Request For Requested Device
HISTG8/21	H6000 Responses/User Request For Requested Device
	Above set of eight histograms is repeated for each requested DATANET or special line ID.

Table 10-1. (Part 3 of 3)

Plot Reports Generated by Default

Report ID/ File Code	Description
PLOT1/31	Transactions Sent to Host (cumulative every 5 minutes)
PLOT2/32	Transactions Received From Host (cumulative every 5 minutes)
PLOT3/33	36-bit Words Sent to Host (cumulative every 5 minutes)
PLOT4/34	36-bit Words Received From Host (cumulative every 5 minutes)
PLOT5/35	% Idle Time Over a 5-Minute Period
PLOT6/36	% Buffer Requests Denied Over a 5-Minute Period
PLOT7/37	18-bits Average Number of Words Available For Buffers Over a 5-Minute Period
PLOT8/38	Average Number of Users Logged On Over a 5-Minute Period
PLOT9/39	Host RSVPs Received by DATANET (cumulative every 5 minutes)

- Amount of activity by DATANET - includes buffer denials, number of transactions sent to and received from the host, number of 36-bit words sent to and received from the host, host RSVPs received, the amount of time spent idle, and a count of the number of users logged onto the DATANET;

- Response time by DATANET and by specified line ID - includes analysis of a series of response time delays;

- HSLA subchannel activity by DATANET - includes number of transmits and receives.

Immediately prior to the reports listing, a summary of processing information is printed. Included in this summary are the following:

- list of all input options selected by the user;

- indication of sequential input tapes being mounted;

- error messages (self-explanatory);

- if the timespan option was used, an indication of when the various timeframes were reached.

In the following sections an example of each report is displayed and a simple explanation of what data was used in the creation of the report is given.

10.5.1 DATANET-355 Tabular Reports. The following tabular reports can be obtained in a data reduction run.

10.5.1.1 Average Response Time for All Users by DATANET (Report RESPD). The report shows the average response times, for each response time category by DATANET. The number of requests and accumulated response times are also displayed. Each response time catagory is defined in subsection 10.3. The report also displays the tapes from which the data was obtained and the date and time to which the report corresponds. The times for which each DATANET was active are given at the bottom of the report. This report is printed as file code 21 at closure of a timespan and end of processing. At each printing, measurements begin anew for each DATANET affected. Refer to figure 10-2 for an example of this report. In generating this report, the individual response times for all terminals on a DATANET are averaged together to determine the response time of the DATANET. In the current version, the default value for the number of terminals that can be processed is 50. If more then 50 terminals can be active, on a given DATANET, the parameter MAXID must be changed via an edit, and the program recompiled. In addition, the size of the program will

AVERAGE RESPONSE TIMES FOR ALL USERS BY DATANET FOR SYSTEM NMCC ON 81-08-27
USING TAPES D0001 D0002 D0003

DATA NET	H6000 DATA ACCEPTANCE TIME NUMBER OF REQUESTS	TOTAL WAIT (SECONDS)	AVERAGE (MSEC)	DN 355 DATA ACCEPTANCE TIME NUMBER OF REQUESTS	TOTAL WAIT (SECONDS)	AVERAGE (MSEC)
0	192	0.960	5.	384	1.920	5.
1	144	0.720	5.	282	1.440	5.

DATA NET	DN 355 PROCESSING TIME NUMBER OF REQUESTS	TOTAL WAIT (SECONDS)	AVERAGE (MSEC)	TRANSMISSION TIME NUMBER OF REQUESTS	TOTAL WAIT (SECONDS)	AVERAGE (MSEC)
0	384	1.920	5.	384	1.920	5.
1	268	1.440	5.	288	1.440	5.

Figure 10-2. Average Response Time for All Uses by DATANET (Report RESPD) (Part 1 of 2)

	USER THINK TIME			H6000 MACHINE RESPONSE TIME		
DATA NET	NUMBER OF REQUESTS	TOTAL WAIT (SECONDS)	AVERAGE (MSEC)	NUMBER OF REQUESTS	TOTAL WAIT (SECONDS)	AVERAGE (MSEC)
0	384	768.000	2000.	372	564.000	1516.
1	268	567.000	2000.	279	423.000	1516.

	SYSTEM RESPONSE PER USER REQUEST			# OF H6000 RESPONSES PER USER REQUEST		
DATA NET	NUMBER OF REQUESTS	TOTAL WAIT (SECONDS)	AVERAGE (MSEC)	NUMBER OF REQUESTS	TOTAL RESPONSES	AVERAGE
0	384	727.000	1893	384	825	2.15
1	268	658.000	2455	268	652	2.43

DATANET 0 SEEN FROM 06:06:00 TO 08:22:00
DATANET 1 SEEN FROM 08:10:00 TO 08:22:00

Figure 10-2. (Part 2 of 2)

increase by 15 words for each integer increase of MAXID. This report will be generated only if the response time portion of the DATANET-355 GMF Monitor was active during data collection (see subsection 5.5.9).

10.5.1.2 <u>HSLA/Subchannel Transmission Report by DATANET (Report BUFF)</u>. This report displays the HSLA subchannel usage by DATANET. For each subchannel being monitored, the number of transmits and receives are printed. A totals line for each DATANET is also displayed. The data for this report is obtained from the terminal monitoring entries (type 3 records) of the host buffer. This report, one for each affected net, is output on file code 21 at closure of a timespan and end of processing. At each printing, measurements begin anew. This report will be generated only if the HSLA monitoring portion of the DATANET-355 GMF Monitor was active during data collection (see subsection 5.5.9). Refer to figure 10-3.

10.5.1.3 <u>Average Response Time for Specifically Designated Line IDs (Report RESPL)</u>. This report presents the average response times, for each response time category, for each line ID designated for special analysis. Each response time category is defined in subsection 10.3. The response times are tallyed on a terminal session basis. A "connect to slave" record (subtype 1 of the response time record entries) initiates the data collection for a specific line ID, and a "line disconnect" record (subtype 7 of the response time record entries) terminates collection. The line disconnect sends a line-of-print to the report, showing the connect and disconnect TOD as well as the average response times for that line ID. A summary paragraph is listed whenever a net disconnect, closure of a timespan or end of processing occurs. The summary shows the average response times for each active line on the net affected, as well as the TODs during which the data was collected. The period during which the data was collected for the summary depends upon what causes the <u>previous</u> summary - a net disconnect resets average response time counters only for line IDs attached to that net. Any other cause resets the average time counters for all line IDs. File code 28 is dedicated to this report. An example is shown as figure 10-4. This report will be generated only if the response time portion of the DATANET-355 GMF Monitor was active during data collection (see subsection 5.5.9).

10.5.1.4 <u>HSLA Subchannels Being Monitored (Report HSLA)</u>. This report, derived from terminal monitoring entries (type 3 records), lists each HSLA number and subchannel monitored for data collection (see subsection 5.9.9) in the GRTS-II monitor run. The report is written once for each DATANET eligible for processing, when the net's first T62 trace is reduced. Figure 10-5 shows an example of this report. It is written to file code 21.

START 08:02:00 81/09/27
STOP 09:00:00

TAPE NOS. 000001 000002

HSLA/SUBCHANNEL TRANSMISSION REPORT FOR DATANET 0

HSLA	HSLA S/C	TRANSMITS	RECEIVES
1	1	13000	13000
1	2	13000	13000
2	1	13000	13000
DATANET 0 TOTALS		39000	39000

Figure 10-3. HSLA/Subchannel Transmission Report (Report BUFF)

START 8:08:00 ON 81/10/27 FOR SYSTEM NMCC FIRST TAPE WAS D0001

AVERAGE RESPONSE TIME IN MILLISECONDS FOR LINE-ID's DG DN DM

LINE-ID	CONNECT TOD	DISCONN TOD	DAC NAME	H6000 ACCEPT TIME	DN ACCEPT TIME	DN PROC TIME	TRANS TIME	USER TIME	MACH TIME	SYST TIME	# RESP
DG	08:10:00	8:12:00	SENDA	5.	5.	5.	5.	2000.	1516	1700	8
SUMMARY FOR THE CHOSEN LINE-ID'S AT 08:13:00 27/10/81 TRIGGERED BY DATANET DISCONNECT											
DN	08:10:05	8:13:00	*UNKN*	5.	5.	5.	5.	2000.	1516	1700	8
SUMMARY FOR THE CHOSEN LINE-ID'S AT 08:13:00 27/10/81 TRIGGERED BY ATANET DISCONNECT											
DM	08:06:08	8:13:00	*UNKN*	5.	5.	5.	5.	2000.	1516	1700	8
DG	08:16:00	8:18:00	SENDA	5.	5.	5.	5.	2000.	1516	1700	8
DG	08:20:00	8:22:00	SENDA	5.	5.	5.	5.	2000.	1516	1700	8
SUMMARY FOR THE CHOSEN LINE-ID'S AT 08:26:00 27/10/81 TRIGGERED BY TIME-SPAN ENDED											
DM	08:16:00	8:26:00	SENDA	5.	5.	5.	5.	2000.	1516	1700	8
DG	08:16:00	8:26:00	SENDA	5.	5.	5.	5.	2000.	1516	1700	8

Figure 10-4. Average Response Time for Designated Lines (Report RESPL)

```
                         START 8:08:00 ON 81/10/27 FOR SYSTEM NMCC

TAPE NOS. D0001 D0002 D0003

          HSLA SUBCHANNELS BEING MONITORED BY DATANET
DATANET 1
               MONITORING HSLA 1 SUBCHANNEL 0
               MONITORING HSLA 1 SUBCHANNEL 1
               MONITORING HSLA 1 SUBCHANNEL 2
               MONITORING HSLA 1 SUBCHANNEL 3
               MONITORING HSLA 1 SUBCHANNEL 4
               MONITORING HSLA 1 SUBCHANNEL 5
               MONITORING HSLA 1 SUBCHANNEL 6
               MONITORING HSLA 1 SUBCHANNEL 7
               MONITORING HSLA 1 SUBCHANNEL 8

DATANET 3
               MONITORING HSLA 1 SUBCHANNEL 0
               MONITORING HSLA 1 SUBCHANNEL 1
               MONITORING HSLA 1 SUBCHANNEL 2
               MONITORING HSLA 1 SUBCHANNEL 3
               MONITORING HSLA 1 SUBCHANNEL 4
               MONITORING HSLA 1 SUBCHANNEL 5
               MONITORING HSLA 1 SUBCHANNEL 6
               MONITORING HSLA 1 SUBCHANNEL 7
               MONITORING HSLA 1 SUBCHANNEL 8
               MONITORING HSLA 1 SUBCHANNEL 9
               MONITORING HSLA 1 SUBCHANNEL 10
               MONITORING HSLA 1 SUBCHANNEL 11
               MONITORING HSLA 1 SUBCHANNEL 12
               MONITORING HSLA 1 SUBCHANNEL 13
               MONITORING HSLA 1 SUBCHANNEL 14
               MONITORING HSLA 1 SUBCHANNEL 15
```

Figure 10-5. HSLA Subchannels Being Monitored (Report HSLA)

10.5.1.5 Card Images from I* of the GRTS-II Data Collection (Report CARD). These card images were originally control data from the GMC. The first card was interpreted by GMC as specifying which of the ten monitors were to remain inactive during the data collection run. If monitor #6, coded "M6," was not listed, then the GRTS-II monitor should have been active and T62 traces expected. Succeeding card images informed GMC of the datanet monitoring options selected by the user (see subsection 5.5). They are repeated here to provide environment data. Figure 10-6 gives an example of this report. It is printed once on file code 21.

10.5.1.6 List of Active Line IDs. Displayed on this report is the identity of each line ID active during the reduction (to a maximum of 50). Only nets selected for analysis (not deselected) contribute. The data is taken from every response time entry (type 2) carrying a line ID tag. The report is listed on file code 23 whenever closure of a timespan, disconnect, or end of processing occurs. Figure 10-7 is an example. This report will be generated only if the response time portion of the DATANET-355 GMF Monitor was active during data collection (see subsection 5.5.9).

10.5.1.7 HSLA Threshold Report (Report THRESH). This report, derived from terminal monitoring entries (type 3 records), indicate whenever the number of transmits or receives, corresponding to any monitored HSLA subchannel (see subsection 5.5.9), exceeds a preset threshold value. The default threshold values are set high so that this report is not normally produced. If the user wants to obtain this report he must activate user input option THRESH (see subsection 10.6.17). The threshold values are compared to the number of transmits or receives monitored across an HSLA subchannel between any two consecutive DATANET traces. The message produced indicates the threshold surpassed (transmits=XMITS, receives=RCVS), the time of day, the HSLA subchannel, and the amount of time that has passed since the previous trace. Figure 10-8 is an example of this report. This report will be written to file code 20.

10.5.1.8 Response Interval Unmatched Pairs Verification. Unmatched pairs are said to occur for a specific line ID when successive data response time records for that line cannot be affirmed as matched pairs (see subsections 10.6.21, 10.3 and 10.5.1.9).

Unmatched pairs are noted within the DATANET-355 Reduction Program, and are printed when discovered. The report appears on file code 42. A summary count is printed whenever closure of a timespan or end of processing occurs. A typical line of output is shown below.

Example of unmatched pairs verification:

```
UNMATCHED ACCEPT DIRECT OUTPUT RECORD FOR DNET 1 LNID DG SUBSYSTEM TSS
TYPE VIP 785 AT 08:09:33
```

```
CARD INPUT IMAGES FROM I* FILE OF THE GMF MONITOR FOR SYSTEM NMCC AT 08:13:00 ON 81/10/27 FIRST TAPE WAS D0001

         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

INPUT CARD # 1   M0 M1 M2 M3 M4 M7 M8 M9
INPUT CARD # 2   D1;HSLA1;SCHO-31;
INPUT CARD # 3   D3;HSLA1;SCHO-31
```

Figure 10-6. Card Images from I* FILE of the GMF Monitor (Report CARD)

```
ACTIVE LINE ID REPORT FOR SYSTEM NMCC AT 08:13:00 ON 81/10/27
USING TAPES D0001 D0002 D0003

              DATANET 1 SEEN FROM  08:02:00 TO 08:12:00  REPORT TRIGGERED BY DATANET DISCONNECT

                                           LINES SEEN ON SELECTED NET
                                               1-DG   1-DA   1-DM
**************************************************************************************************************

              DATANET 0 SEEN FROM  08:02:00 TO 08:12:00  REPORT TRIGGERED BY DATANET DISCONNECT

                                           LINES SEEN ON SELECTED NET
                                                  0-AD   0-AB
**************************************************************************************************************

              DATANET 1 SEEN FROM  08:16:00 TO 08:26:00  REPORT TRIGGERED BY DATANET DISCONNECT

                                           LINES SEEN ON SELECTED NET
                                               1-DG   1-DA   1-DM
**************************************************************************************************************
```

Figure 10-7. List of Active Line IDs

```
HSLA THRESHOLD REPCRT FOR SYSTEM NMCC AT 08:15:00 ON 81-10-27     FIRST TAPE D0001

HSLA THRESHOLD ** FOR DNET 1 AT 08:25:00 HSLA 1 HSALSC 2 XMITS INCREASED BY 3000--TIME SINCE PREV RCD THIS NET = 240.00
                                                                                                             SECONDS

HSLA THRESHOLD ** FOR DNET 0 AT 09:15:20 HSLA 2 HSLASC 5 RCVS INCREASED BY 2700--TIME SINCE PREV RCD THIS NET = 240.00
                                                                                                             SECONDS
```

Figure 10-8. HSLA Threshold Report (Report Thresh)

This message indicates that the data is not being received in the order expected and should be considered as an error condition. CCTC (C751) should be contacted when this condition is found to exist. A similar problem exists if the word "UNMATCHED" is replaced by the word "DUPLICATE." Both these cases indicate data not being received in the order expected. Table 10-2 displays all such occurrences of these messages and reasons for the problem. This report will be generated only if the response time portion of the DATANET-355 GMF Monitor was active during data collection (see subsection 5.5.9).

10.5.1.9 Response Interval Matched Pairs Verification (Report MATCH). Data transmission between host and front end is governed by the series of events described in section 10.3. A matched pair is affirmed on detecting any sequence that generates a valid response time measurement as described in section 10.3, for the same line ID within a single T62 trace. This report will be generated only if the response time portion of the DATANET-355 GMF Monitor was active during data collection (see subsection 5.5.9).

Matched pairs are noted within the DATANET-355 Data Reduction Program, and are printed when affirmed, and when both the following two conditions are true: (1) the option has been specifically selected (see subsection 10.6.15) and (2) the response time threshold (separately specified for each response time category) has been exceeded. The report appears on file code 20. A typical line of output is shown below.

Example of matched pairs verification:

DN-355 DATA ACCEPTANCE TIME FOR 75 SECS ON DNET 1 FOR LNID DG TYPE = VIP 7855 FOR SUBSYSTEM VIDEO AT 08:08:12

This report may be used to capture the occurrence of response or processing times that are considered to be excessive.

10.5.1.10 Annotated List of Datanet Traces (Report TRACE). This report can only be produced by use of the special input option TRACE (see subsection 10.6.12). It will produce voluminous output and should only be used for debug purposes. The report will produce a formatted dump of the various DATANET 355 GMF data records and is only meaningful to someone familiar with the correct record formats. No sample of this report is given in this document.

10.5.2 Plots. The plots described in the following subsections can be obtained from a data reduction run. Table 10-1 lists the data collections that can be plotted. Each plot contains the information for all known DATANETs. Plot listings are found on file code 25. Since the plots can produce a tremendous amount of output, it is suggested that the plot time interval not be made too small. The

Table 10-2. Response Time Error Messages

ERROR MESSAGE	REASON
Duplicate Send Output	A duplicate event 2 has been received before the occurrence of an event 3 or 4.
Duplicate Accept Direct Output or Duplicate Accept Direct Output/Input	A duplicate event 3 or 4 has been received before the occurrence of an event 8.
Unmatched Accept Direct Output or Unmatched Accept Direct Output/Input	An event 3 or 4 has occurred before an event 2 or 6.
Unmatched Accept Direct Input	An event 5 has occurred before an event 10.
Unmatched Input Accepted	An event 6 has occurred before an event 5.
Duplicate Input Accepted	A duplicate event 6 has been received before the occurrence of an event 3 or 4.
Duplicate Total System Response Time	A duplicate event 6 has occurred before an event 4.
Unmatched Output Received	An event 8 has occurred before an event 3 or 4.
Duplicate Output Received	A duplicate event 8 has occurred before an event 9.
Unmatched Output Started	An event 9 has occurred before an event 8.
Duplicate Output Started	A duplicate event 9 has occurred before an event 10.
Duplicate Output Completed	A duplicate event 10 has occurred before the occurrence of an event 5.
H6000 Rejected Accept Direct Input (THIS IS IS NOT AN ERROR CONDITION)	H6000 too busy to respond to DN 355, see subsection 10.6.22.

default plot interval is five minutes and can be changed with a user input option (see subsection 10.6.14).

One horizontal line is output at the specified, or default, plot time interval. Every tenth line displays the current time of day. If a curve ordinate is on or beyond the axis limit, it will be positioned at the axis limit. If two or more curves share the same ordinate simultaneously, the position of coincidence will be marked with the cardinal number of the curves sharing it. The cell "height" (value of one increment along the horizontal axis) is specified by a DELTA value given in the heading. The vertical axis is the time axis with nominal increments of one plot time interval, but rarely will the increments be equal. The parameters which determine the plot delta intervals (horizontal increments) are described in subsection 10.4 and methods for altering the parameters are described in subsection 10.6.2. Each plot contains a heading line giving the date and the starting time of the collection, a title describing the collection, the identifying mark of each curve, and the DELTA value. When the plot time interval is exceeded for any given DATANET, all DATANETs will be plotted. Therefore, it is probable that in a multiple DATANET environment a given plot entry will reflect different amounts of time for each of the DATANETs. In order to make the plots more readable, it is suggested that only a single DATANET be plotted at one time. This will require multiple reductions to be run, turning off the plot option for different DATANETs, but output will be easier to read. The method for doing this is described in subsection 10.6.13.

10.5.2.1 <u>Number of Transactions Sent to Host (Plot ID PLOT1)</u>. This report plots the cumulative number of transactions sent to the host, over a plot interval of time, by DATANET, as obtained from the host buffer for CPU utilization (record type 1, subtype 4). Figure 10-9 shows an example. In this plot we see that DATANET 0 has accumulated 3560 transactions between 0800, when the monitor started, and 0822, when the first plot entry was made. In this plot, each dash (delta value) is equivalent to 40 transactions, and therefore, the "A" is plotted at the 89th dash mark. During that same interval of time, DATANET 1 had accumulated 4400 transactions. From 0822 until the next plot interval of time (approximately 15 minutes, depending on when the data buffer was received), DATANET 0 again accumulated 3560 transactions, but DATANET 1 accumulated only 2520 transactions. Therefore, the B is written out at the 63rd mark. The plots need to be read as a continuous line of output. Therefore, the user will need to connect the same lettered points in order to track the change that has occurred. During the next time interval, DATANET 0 decreased to 2520 transactions, while DATANET 1 increased to 3560 transactions.

10.5.2.2 <u>Number of Transactions Received From Host (Plot ID PLOT2)</u>. This report plots the cumulative number of transactions received from

AD-A116 898 COMMAND AND CONTROL TECHNICAL CENTER WASHINGTON DC F/G 17/2
GENERALIZED MONITORING FACILITY. USERS MANUAL.(U)
MAY 82 B WALLACK, G H GERO
UNCLASSIFIED CSM-UM-246-82 NL

5 of 6
AD A
116898

```
                    DISTRIBUTION COLLECTED ON SYSTEM NMCC AT 8:00:00 ON 04-10-81

               TRANSACTIONS SENT TO HOST (CUMULATIVE/15 MIN)                       PLOT-1

DELTA=   4.0000E 01   A=DNET 0  B=DNET 1  C=DNET 2  D=DNET 3

TIME OF DAY                          SCALED COUNTS
     0               1240                  2520                  3760       4400

y---------y---------y---------y---------y---------y---------y---------y---------y---------y---------y---------y

X  08:22;:00                                                          A                    B
2                                                       B             A
2                                                       A             B
```

CURVE	MINIMUM	MAXIMUM	AVERAGE
DNET 0	0.2520E 04	0.3560E 04	0.3213E 04
DNET 1	0.2520E 04	0.4400E 04	0.3473E 04
DNET 2	0.	0.	0.
DNET 3	0.	0.	0.

Figure 10-9. Number of Transactions Sent to Host (Plot 1)

the host, over a plot interval of time, by DATANET, as obtained from the host buffer for CPU utilization (record type 1, subtype 5). This plot should be interpreted in the same manner as figure 10-9 and therefore no example is included.

10.5.2.3 Number of 36-Bit Words Sent to Host (Plot ID PLOT3). This report plots the cumulative number of 36-bit words sent to the host, during a plot interval of time, by DATANET, as obtained from the host buffer for CPU utilization (record type 1, subtype 6). This plot should be interpreted in the same manner as figure 10-9 and therefore no example is included.

10.5.2.4 Number of 36-Bit Words Received From Host (Plot ID PLOT4). This report plots the cumulative number of 36-bit words received from the host, during a plot interval of time, by DATANET, as obtained from the host buffer for CPU utilization (record type 1, subtype 7). Figure 10-10 provides a sample of this type plot and should be interpreted in the same manner as figure 10-9. Note the occurrence of the 2's as both Datanet A and B have reported identical values during the second and third time increments.

10.5.2.5 Percent Idle Time Over a Plot Interval (Plot ID PLOT5). This report plots the percent of time, over a plot interval, that each DATANET was idle. If a DATANET crashes during this interval, the amount of time spent down, due to the crash, is disregarded (i.e., the length of the interval for the DATANET that crashed will be reduced by the amount of time the DATANET was down). This information is obtained from the host buffer for CPU Utilization (record type 1, subtype 9). Figure 10-11 provides an example of this plot. In examining this plot, it can be seen that during the first time interval, DATANET 0 was 32 percent idle, while DATANET 1 was 30 percent idle. During the second time interval, DATANET 0 became 27 percent idle, while DATANET 1 remained 30 percent idle. During the third time interval, DATANET 0 had a 29 percent idle time, while DATANET 1 had a 27 percent idle time.

10.5.2.6 Percent Buffer Requests Denied (Plot ID PLOT6). This report plots the percent of buffer requests that were denied during a single plot interval of time, by DATANET, as obtained from the host buffer for CPU utilization (record type 1, subtype 1 and 10). As can be seen in the figure, two DATANETs are being monitored for three time intervals. Both DATANETs are reporting 60 percent of their buffer requests being denied. Since two DATANETs are reporting the same value, the number "2" appears on the plot, indicating the intersection of two values. Refer to figure 10-12 for a sample of this type plot.

10.5.2.7 Number of 18-Bit Words Available For Buffers (Plot ID PLOT7). This report plots the average number of 18-bit words vailable for buffers, over a plot interval of time, by DATANET, as

```
                         DISTRIBUTION COLLECTED ON SYSTEM NMCC AT 8:00:00 ON 04-10-81

               36-BIT WORDS RECEIVED FROM HOST (CUMULATIVE/15 MIN)                              PLOT-4

DELTA=   4.0000E 01   A=DNET 0  B=DNET 1  C=DNET 2  D=DNET 3

TIME OF DAY                                  SCALED COUNTS
     0                 1240                       2520                      3760         4400

y---------y---------y---------y---------y---------y---------y---------y---------y---------y---------y---------y

X  08:22:00                                                                          A            B
2                                                                                    2
2                                                                                    2

   CURVE       MINIMUM       MAXIMUM       AVERAGE
DNET 0         0.3760E 04    0.3760E 04    0.3760E 04
DNET 1         0.3760E 04    0.4360E 04    0.3960E 04
DNET 2         0.            0.            0.
DNET 3         0.            0.            0.
```

Figure 10-10. Number of 36 Bit Words Received From Host (Plot 4)

```
                    DISTRIBUTION COLLECTED ON SYSTEM NMCC AT 8:00:00 ON 04-10-81

          % IDLE TIME/15 MINUTES                                                   PLOT-5

DELTA=    1.0000E 00   A=DNET 0  B=DNET 1  C=DNET 2  D=DNET 3

TIME OF DAY                                           SCALED COUNTS
     0                31                    63                    94          110

y---------y---------y---------y---------y---------y---------y---------y---------y---------y---------y---------y

X  08:22:00            B A
2                    A  B
2                    B A

   CURVE        MINIMUM       MAXIMUM       AVERAGE
DNET 0        0.2700E 02    0.3200E 02    0.2933E 02
DNET 1        0.2700E 02    0.3000E 02    0.2900E 02
DNET 2        0.            0.            0.
DNET 3        0.            0.            0.
```

Figure 10-11. Percent Idle Time (Plot 5)

```
                    DISTRIBUTION COLLECTED ON SYSTEM NMCC AT 8:00:00 ON 04-10-81

                % BUFFER REQUESTED DENIED/15 MIN                                   PLOT-6

DELTA=   1.0000E 00   A=DNET 0  B=DNET 1  C=DNET 2  D=DNET 3

TIME OF DAY                                                  SCALED COUNTS
     0                   31                        63                       94          110

y---------y---------y---------y---------y---------y---------y---------y---------y---------y---------y---------y

X  08:22:00                                                  2
2                                                            2
2                                                            2

   CURVE        MINIMUM        MAXIMUM        AVERAGE
DNET 0          0.6000E 02     0.60000E 02    0.60000E 02
DNET 1          0.6000E 02     0.60000E 02    0.60000E 02
DNET 2          0.             0.             0.
DNET 3          0.             0.             0.
```

Figure 10-12. Percent Buffer Requests Denied (Plot 6)

obtained from the host buffer for CPU utilization (record type 1, subtype 2). This plot is interpreted in the same manner as other plots and therefore, an example is not provided.

10.5.2.8 Number of Users Logged On The System (Plot ID PLOT8). This report plots the average number of users logged on each DATANET, during a plot interval of time, as obtained from the host buffer for CPU utilization (record type 1, subtype 3). This plot is interpreted in the same manner as other plots and therefore, an example is not provided.

10.5.2.9 Number of Host RSVPs Received (Plot ID PLOT9). This report plots the cumulative number of host RSVPs received, during a plot interval of time, by DATANET, as obtained from the host buffer for CPU utilization (record type 1, subtype 8). This plot is interpreted in the same manner as other plots and therefore, an example is not provided.

10.5.3 Histograms. Histogram reports are produced for each response time category described in section 10.3. Histograms can be produced for all known DATANETs (up to four) and special line IDs (up to 10). Included on each listing are the time and date the data were collected, the system name on which they were collected, response category, and the report ID. The histogram proper includes cells count and frequency, both individual and cumulative, as well as the range and scale of each cell. A bar chart comparing the cell frequencies, and a statistical summary of in-range and out-of-range events completes the chart. Figures 10-13 and 10-14 show sample histograms as produced by a DATANET and a special line ID. Histograms will be outputted at the end of a timeframe or at the end of processing. A closing line on each histogram shows the TODs between which the histogram data are valid, and why the histogram was printed. Successive histograms for the same application are never cumulative.

Figure 10-13 will be used to describe the procedure that should be followed in interpreting a histogram. Entries in the column headed SECOND give the range of times which form each histogram bucket. The first bucket is used to report 0 measured values, if any, with all other buckets used to represent a range of values. The user should refer to subsection 10.4 for a discussion of range values within histograms and subsection 10.6.20 for the method of altering the standard ranges. The entries in the column headed INDIV. NUMBER give the number of reponses that were measured that fell within the time range specified by the SECOND column. In figure 10-13, we observe that 144 responses measured between 2 and 3 seconds.

```
                 DISTRIBUTION COLLECTED ON SYSTEM NMCC AT 8:08:00 ON 04-11-81

                 H6000 MACHINE RESPONSE TIME FOR DATANET 1

INDIV.   CUMUL.   CUMUL.   INDIV.   SECOND                PERCENT OF OCCURRENCE
NUMBER   NUMBER   PRC.     PRC.           00   10   20   30   40   50   60   70   80   90  100
                                           I....I....I....I....I....I....I....I....I....I....I
135        135    0.484    0.484     1-  1 Ixxxxxxxxxxxxxxxxxxxxxxxx
144        279    1.000    0.516     2-  3 Ixxxxxxxxxxxxxxxxxxxxxxxxxx

279 ENTRIES TOTAL    AVERAGE =    1.51613   VARIANCE =    0.250   STANDARD DEVIATION =    0.500

TRIGGERED BY TIME - SPAN ENDED   AT 08:26:00
DNET 1 SEEN FROM 08:10:00 TO 08:22:08
```

Figure 10-13. Histogram of DATANET Response

```
                         DISTRIBUTION COLLECTED ON SYSTEM NMCC AT  00:00 ON 04-11-81

                         H6000 MACHINE RESPONSE TIME FOR LNID   DC
INDIV.   CUMUL.   CUMUL.   INDIV.   SECOND
NUMBER   NUMBER   PRC.     PRC.                     PERCENT OF OCCURRENCE
                                          00   10   20   30   40   50   60   70   80   90   100
                                           I....I....I....I....I....I....I....I....I....I....I
195        195    0.484    0.485     1-  1 Ixxxxxxxxxxxxxxxxxxxxxxxx
208        403    1.000    0.516     2-  3 Ixxxxxxxxxxxxxxxxxxxxxxxxxx

403 ENTRIES TOTAL    AVERAGE =     1.51313     VARIANCE =     0.250     STANDARD DEVIATION =     0.500

TRIGGERED BY END-OF-FILE        AT 09:00:00
DNET 0 SEEN FROM 08:02:00 TO 09:00:00
```

Figure 10-14. Histogram Special Line ID Response

Similarly, the columns headed INDIV. PRC and CUMUL. PRC give the individual and cumulative percentages of all responses which were made within each time range. In figure 10-13, we observe that 48% of all responses were 1 second in duration, while 51% were between 2 and 3 seconds in duration. At the same time, it can be observed (CUMUL. PRC) that 100% of all responses were measured at 3 seconds or less.

10.6 Default Option Alteration

The DDRP uses the trace tape generated by the GMC and user data cards as input. The user has several optional inputs. These options are evoked by specifying an input option (action code) and any other required inputs specified in the following subsections. The general format for an option request is as follows:

The first card is an action code describing the action to be taken. Subsequent cards modify report parameters for some of the action codes. All inputs are free format with the only requirement being that all zeros must be typed on the data card. At least one data card with the word END specified is required as the last data card.

Available action codes (and default implications) (and character code) are:

1. Turn histogram on; (no histograms) (HISTG)

2. Modify a plot; (standard plots) (PLOT)

3. Turn a specific report on; (all reports on except ID TRACE, MATCH, and histograms) (ON)

4. Turn a specific report off; (all reports on except ID TRACE MATCH, and histograms) (OFF)

5. Set a timespan for measurement; (time not a criterion for measurement) (TIME)

6. Process Data Reduction Program on a WW6.4/2H system (WW7.2/4JS processing) (RN)

7. Turn all reports off except those specified; (all reports on except ID TRACE, MATCH, and histograms) (ALLON)

8. Turn all reports on except those specified; (all reports on except ID TRACE, MATCH, and histograms) (ALLOFF)

9. Do not stop on an option request error; (stop on an input error) (ERROR)

10. Number of physical tape records to process before stopping; (number of records not a constraint) (NREC)

11. All reports off except plots; (all reports on except ID TRACE, MATCH, and histograms) (REPORT)

12. Dump formatted record types listed; (no dump) (TRACE)

13. DATANETs not to analyze for plots; (all are plotted) (NOPLOT)

14. Set minimum plot interval; (five minute plot interval) (INTERV)

15. Verify response time records (type 2) matched (at end of processing of each T62 trace) (no verification) (MATCH)

16. Accept line IDs for special analysis; (none get special analysis) (SPECL)

17. Modify threshold values (all values 9999999) (THRESH)

18. DATANETs not to analyze for reports other than plots; (all nets are analyzed) (NORPT)

19. Debug (no debug) (DEBUG)

20. Modify parameters for histograms (default values described in section 10.4) (CHANGE)

21. Error Report (all unmatched responses produced) (DUPLIC)

22. Reject Report (reject messages are produced but summary is not). (REJECT)

There is no order required for the options, and multiple entries in each are permissible. If several inputs refer to the same report, the last one encountered will have precedence. Also, if a report is off by default and is modified, it will be turned on through its request for modification. All input cards are free format unless otherwise described. If multiple parameters occur on a given card they must be separated by at least 1 blank column.

Three tabular reports depart from the normal scheme (see table 10-1): the reports titled "List of Active Line IDs" and "Response Interval Unmatched Pairs Verification" are generated if a T62 trace is processed and cannot be turned off. The report titled "Response Reject Messages" is also produced by default and can only be altered with the REJECT user option.

10.6.1 Histogram Desired (Action Code HISTG). If the user desires histograms, he must use this action code. There is no other method for obtaining histograms. The user may obtain histograms for either DATANETs or special terminals. This option would be used for obtaining DATANET histograms. Terminal histograms can be requested under action code "SPECL". For every requested DATANET and/or terminal, a set of eight histograms will be produced. Currently, the data reduction program can produce a maximum of 40 histograms (five sets of eight histograms each). If more than this are desired, the user will need to edit and recompile the source code. In performing the edit, the user should change the value of "RPTCNT" from the current setting of 57 to the required new value. To calculate the new value of "RPTCNT," the following formula should be used:

RPTCNT = 17 + 8* (number of sets of histograms desired)

It should be noted that for every integer increase in the value of RPTCNT, the amount of memory required to run this program increases by 80 words. The first card contains the word HISTG and the second card contains the DATANET number (0-3) for which the histograms are desired.

10.6.2 Plot Alteration (Action Code PLOT). For any given plot the user can alter the maximum number of lines to be printed on the plot, the minimum value of the plot and the maximum value of the plot (see subsection 10.4). By specifying the minimum and maximum values of the plot, the user has in effect specified the interval size of the plot. If a value to be plotted is smaller then the minimum value specified, the element will be plotted so as to intersect the left axis of the plot. If a value to be plotted is larger then the maximum value specified, the element will be plotted as an asterisk on the right hand axis of the plot. If the user wants to insure that the entire plot is printed, he should input a value of -1 for the number of lines to be printed. The minimum and maximum values must be specified as real numbers, i.e. decimal points must be punched on the data card. Table 10-1 lists those measurements currently being plotted and figure 10-1 lists the default values for all plots. Figure 10-15 shows the format required for this action code.

10.6.3 Turn a Report On (Action Code ON). This action allows a user to turn a single report on (that is off by default) for this run. The user specifies the report ID (see table 10-1). No change to the default parameters will be made, and a report already on will remain on. All reports are on by default except the histograms, and report ID's TRACE and MATCH. None of these can be turned on by using this option. To turn histograms on, the user must use the "HISTG" or "SPECL" options, and to turn on the other two reports, the user must use the "TRACE" and "MATCH" options respectively. This option is only included for completeness and will never need to be used. The format

Card #1 A
Card #2 B C D E

Where

A = The letters PLOT
B = Plot ID to be altered (see TABLE 10-1)
C = Number of lines to be printed or a -1 if entire plot is desired
D = Maximum value for plot inputted as a real number, i.e. with decimal point
E = Minimum value for plot inputted as a real number, i.e. with decimal point

Figure 10-15. Plot Alteration (Action Code-PLOT)

consists of two cards. The first contains the word ON and the second card contains the report ID from table 10-1 to be turned on.

10.6.4 <u>Turn a Report Off (Action Code OFF).</u> This action permits a user to turn a single report off (that is on by default) for this run. The user specifies the report ID (see table 10-1). No change of default parameters is made, and a report may be turned off multiple times. All reports and plots that are currently on by default can be turned off with this option except for the report titled "Response Reject Messages." This report can be altered only with the use of the input option REJECT. The format for this option is the same as the ON option except the word OFF replaces the word ON.

10.6.5 <u>Set a Timespan of Measurement (Action Code TIME).</u> The system allows a user to specify the timespan (or spans) in which the collected data is to be processed and reports generated. For example, the user may collect data from 0500 to 2200 hours and specify that he wants to process only 0900 to 1700 hours on all reports. The timespans set through this option apply to all report processing.

Up to five timespans may be specified and they must be chronologically ordered. In specifying timespans a start time and a stop time must be supplied. If a start time is specified, but no stop time is specified, there should be no data on the card after the start time is specified. All times are expressed as S1M1 where S1 is the start hour and M1 is the start minute. All times must be expressed as 4 character fields with no intervening blanks. If the user wants to request the time 4:07 he must input a "0407". Times are considered to be on a 24 hours clock.

Individual timespans may be set for the entire data reduction run (report ID=TOTAL), or for report ID's THRESH and TRACE, or for any plot. Report ID's for plots are indicated in TABLE 10-1. No other individual timespans may be set. The format for this card is shown in figure 10-16.

10.6.6 <u>Process Reduction on a WW6.4/2H System (Action Code RN).</u> The data reduction program is designed to be processed on a WW7.2/4JS GCOS release. However, the program can be executed under a WW6.4/2H GCOS system with the use of this option. The option consists of an RN typed on the data card.

10.6.7 <u>Turn All Reports Off Except Those Specified (Action Code ALLOFF).</u> All reports except those explicitly identified here are to be turned off. The card format is shown in figure 10-17.

10.6.8 <u>Turn all Reports On Except Those Specified (Action Code ALLON).</u> All reports except those explicitly identified here are to be turned on. The card format is shown in figure 10-18. This action

```
Card 1     A
Card 2     N    M
Card 3     B    C    D    E    F .....
```

Where

A = The letters TIME
N = Report ID to be timespanned. (see subsection 10.6.5)
M = Number of different times appearing on card 3
B, C, D, E, F = Start and stop times used to define the timespan. (see subsection 10.6.5)

Figure 10-16. Set Timespan(s) For Processing (Action Code TIME)

```
Card 1     A
Card 2     N
Card 3     I    J    K . . .

           Where

A = The letters ALLOFF
N = The number of reports to be specified on card 3
I, J, K = Report ID's (from TABLE 10-1)
           not to be turned off.  N of these numbers
           must appear on this card.
```

Figure 10-17. Action Codes For Turning Reports Off

```
Card 1      A
Card 2      N
Card 3      I    J    K . . . .

            Where

A = The letters ALLON
N = The number of reports to be specified on card 3
I, J, K = Report ID's (from TABLE 10-1) not to be turned
            on.  N of these numbers must appear on this card.
```

Figure 10-18. Action Codes For Turning Reports ON

cannot be used to turn on histograms. Action codes "HISTG" and "SPECL" must be used for histograms. It also should not be used to turn on report ID's MATCH and TRACE. These two reports are turned via special input options. For these reasons the user should never use this option and it is provided only for a matter of completeness.

10.6.9 Continue Data Reduction After an Input Option Error (Action Code ERROR). This code allows data reduction to continue when an error has been detected in an input option request. The default value will abort data reduction and report the error. No cards are required after the action card which contains the word ERROR.

10.6.10 Stop Processing (Action Code NREC). This option permits a user to specify the number of tape records to process before stopping. This is useful if a hard tape error aborts the run and causes reports to be lost. In order to obtain these reports, it is necessary to stop processing prior to the tape error. The first card contains the word NREC and the second card contains the number of tape records to be processed.

10.6.11 Plots Only (Action Code REPORT). This action code permits the plots to be generated and curtails all other reports. No cards are required after the action card which contains the word REPORT.

10.6.12 Print formatted DATANET-355 Record Types (Action Code TRACE). The GRTS-II monitor of the GMC distinguishes three record types, designated 1, 2, and 3. Generally, type 1 records provide gross net performance data; type 2 records capture events pertinent to each line ID; type 3 records show gross performance of each HSLA subchannel. This Action code permits the user to specify which type record to format and print. An additional option allows selection of a header showing various counters and clocks.

The first card contains the word TRACE. The second card would indicate which of the possible options the user is going to describe. This card can contain the word TERM, or LIMIT, or RECTYP, or END.

If the word TERM appears on the second card, then the third card would contain the number of terminals (maximum of four) for which the type two records are to be formatted. The fourth card would contain the list of terminal IDs for which type two record formatting is desired. The IDs should be separated by at least one blank.

The next card would once again contain the word LIMIT, or RECTYP, or END.

If the word LIMIT appears on the card then the following card would contain the number of GRTS records that should be formatted before the formatting option will be deactivated. The card following would once again contain the word RECTYP, or END.

If the word RECTYP appears on the card then the following card would contain the number of record types desired and the DATANET for which they are desired. A zero for a DATANET # must be typed. A DATANET number of -1 indicates that all DATANETs should be processed in the requested manner. The following card would list the actual record types desired. The card following should contain the word END.

If the word END appears on the card processing of the dump option will terminate. Any combination of the above options may follow a TRACE action card, but the END card must be the last card of the group. The TRACE report is off by default and will be activated by the processing of this option.

10.6.13 DATANETs Not to Plot (Action Code NOPLOT). This option permits the user to "turn off" plot data for specified DATANETs. The effect on an active plot is to zero the Y-coordinate for the unwanted DATANET. The DATANET identifiers are 00 through 03. This option should be used when reducing a tape containing data from multiple DATANETs. Under the default conditions, data from every DATANET will appear on the same plot, as different curves. While this allows the user to easily compare the activity on multiple DATANETs it does present several problems. One problem is that the plot tends to be difficult to read because of the large amount of data contained in a small area. The other problem is one of plot limits. If the activity on the various DATANETs is significantly different, it becomes difficult to set meaningful minimum and maximum plot boundaries.

By turning off plots for specified DATANETs, the user can see each DATANET plotted separately, or else only see certain DATANETs plotted together. If the user selects this option, multiple reductions will need to be run in order to see the plots for all DATANETs. Figure 10-19 shows the format for this action.

10.6.14 Set a Plot Interval (Action Code INTERV). This option allows the user to set the minimum plot interval. The interval criterion is applied to each DATANET individually and if the test approves the plot, the latest data from all DATANETs are plotted. The default interval is 5 minutes (300 seconds). The first card contains the word INTERV and the second card contains the new plot interval in seconds.

10.6.15 Response Time Records (Type 2) Matched (Action Code MATCH). This option causes a message to be printed whenever a response interval is completed (matched). This option can produce voluminous output and should be used with caution if the data tape contains more than a few records. The "matched" option can be used to track the origin of unusual response times reported in DATANET and special-analysis line ID histograms. A series of seven threshold

Card 1 A
Card 2 N
Card 3 M L O....

Where

A = The letters NOPLOT
N = Number of DATANETs appearing on the third card, whose plots will be turned off
M, L, O = DATANET numbers whose plots are to be turned off. N such numbers must appear on card.
If the DATANET number is 0, the 0 must be punched on the card.

Figure 10-19. Turn Off Plots (Action Code NOPLOT)

values can be specified to force the tracking of times greater than, or equal to, the threshold value. The definition of the various response times are given in sections 5.2.7.7.3, 5.4.8, and 10.3 of this document. The first card contains the word MATCH. The second card would contain the seven new threshold values that are desired. Seven numbers must appear on this card. The threshold must be expressed in milliseconds. This report is not produced under default conditions and will be turned on by the occurrence of this option.

10.6.16 Accept Line IDs for Special Analysis (Action Code SPECL). Up to 10 line IDs can be designated for special analysis on a terminal session basis, i.e., from line connect to line disconnect. Each session is summarized on the tabular report ID RESPL.

It is also possible to obtain histograms for these special lines. In this case, both tabular reports and histograms would be produced. If the histogram option is selected, the user must insure that the value of "RPTCNT" is set correctly (see subsection 10.6.1). If the user wants more than 10 line IDs investigated, the internal parameter "MXSPEC" can be altered, via an edit, and the program recompiled. All occurrences of "MXSPEC" must be changed. For each integer increase in "MXSPEC", and additional 30 words of memory is required. The first card contains the word SPECL. The second card would contain the number of special terminals desired and the third card would contain a list of terminal IDs separated by at least one blank.

The terminal IDs should be expressed as a 2 character field followed immediately by an H or N. The "H" signifies that histograms are desired, while the "N" signifies that no histograms are desired.

10.6.17 Modify Threshold Values (Action Code - THRESH). This option causes a warning message to be issued whenever the event count corresponding to any HSLA subchannel exceeds the specified threshold value since the previous trace for that DATANET. Two threshold values can be specified. They correspond to the following event counts on the HSLA subchannel: transmits and receives. The default values for these counts are initially set high enough that the warning messages should not be issued. In addition, the user may request that a message be produced every time the number of buffer denials exceeds a certain value or the number of available words of buffer space falls below a certain value. This information is provided only when plots are being produced. Figure 10-20 shows the cards required for this action.

10.6.18 Suppress Nonplot Reports for Selected Nets (Action Code - NORPT). This option allows the turning off of all reports (other than plots) for a specified DATANET. Figure 10-21 shows the format for this action.

Card 1   A
Card 2   B
Card 3   C   D

Where

A = The letters THRESH
B = The letters AVAIL if we are setting buffer space availability; the letters DENIAL if we are setting buffer denial threshold; or the letters HSLA if we are setting HSLA activity thresholds.
C, D = Actual threshold values. D will be blank if card 2 was an "AVAIL" or a "DENIAL" card.

Figure 10-20. Threshold Values (Action Code THRESH)

Card 1   A
Card 2   N
Card 3   M   L   O ...

Where

A = The letters NORPT
N = Number of DATANETs appearing on the Third card, whose reports will not be produced
M, L, O = DATANET numbers whose reports are to be turned off. N such numbers must appear on card. If the DATANET number is 0, the 0 must be punched on the card.

Figure 10-21. Turn off Reports For Selected DATANETs (Action Code NORPT)

10.6.19 Debug (Action Code DEBUG). Extensive debug facilities are provided within the program. By default all debug is turned off. This option should be used only by somebody very familiar with the logic of the program. Figure 10-22 shows the format for this action.

10.6.20 Alter Histogram Default Parameters (Action Code CHANGE). The user should reference section 10.4 for a discussion of Histogram Parameters. Figure 10-23 provides the format for this option.

10.6.21 Unmatched/Duplicate Error Report (Action Code DUPLIC). In processing response time data, it has been discovered that responses may not be received in an order considered correct by the data reduction program. This can occur because of a lost data occurrence or because of an anomoly in the functioning of the DATANET-355. The correct order and an explanation of the responses being captured are presented in sections 5.2.7.7.3, 5.4.8, and 10.3 of this document. Normally, when this error occurs an error message will be produced. Table 10-2 shows the various error messages that may be produced and describes when they would occur. This option allows the user to turn off these error messages, or else produce the error messages only for those terminals selected for special analysis (action code SPECL). Figure 10-24 provides the format for this option.

10.6.22 Special Reject Report (Action Code REJECT). Instances occur when the H6000 will reject a DATANET-355 request for service. This rejection normally occurs when the H6000 is to busy to immediately respond to the 355 interrupt. In these cases the DATANET will be forced to retransmit its request. When this event is detected, the data reduction program will produce a reject error message. In addition, a summary of the number of such rejects may also be produced. Under default conditions, this summary report is not produced. This option allows the user to turn off the error messages or else to request the summary report. Figure 10-25 provides the format for this option.

10.7 JCL

The following paragraphs describe the JCL usage necessary for reducing a GRTS-II monitor data tape. The usual $ SNUMB, $ IDENT, and $ USERID cards are included as required for the installation. The program is controlled by the following JCL cards:

```
$ LOWLOAD
$ OPTION FORTRAN
$ SELECT B29IDPXO/OJBECT/GRT
$ LIMITS 20,48K,-2K,10000
```

Card 1 A
Card 2 B C

Where

A = The letters DEBUG
B = The letters TYPE1 if type 1 and type 3 records are to be debugged; or the letters TYPE2 if type 2 records are to be debugged; or the letters BOTH if all records are to be debugged.
C = DATANET number to be debugged

Figure 10-22. Debug Option (Action Code DEBUG)

```
Card 1      A
Card 2      B    C    D
```

Where

A = The letters CHANGE
B = The letters LOW if the low value is modified or the
    letters INTEV if the interval size is modified.
C = Histogram ID to be modified (see table 10-1)
D = New parameter

Figure 10-23. Alter Histogram Parameters
(Action Code CHANGE)

Card 1   A
Card 2   B

Where

A = The letters DUPLIC
B = The letters Off if the error messages are not desired at all, or the letters TERM if the error messages are desired only for special terminals

Figure 10-24. Unmatched/Duplicate Error Report (Action Code DUPLIC)

```
Card 1      A
Card 2      B

            Where

A = The letters REJECT
B = The letters OFF will turn off the reject
    error message but produce the summary reports.
    The letters BOTH will cause the error messages to
    be produced as well as the summary report.
```

Figure 10-25. Reject Report
(Action Code REJECT)

The run time, 0.2 hour, and SYSOUT limits, 10000 lines, may be altered as required by the scope of the monitored run. During the loading process, the program will reach a memory size of 56K, but the extra 8K will be released immediately upon loading.

The GRTS-II monitor data tape specifications are provided by the following card:

```
$ TAPE 01,X1D,,tape.no,,NO-RING
```

The TAPE card specifies the tape type (7- or 9-track) and the tape number.

The input options file is identified by a

```
$ DATA I*
```

card, followed by the option cards as described in section 10.6. At least one data card containing an "END" must be present.

10.8 Multireel Processing

If more than a single reel of data has been collected a series of messages will be printed at the computer console informing the operator that a new data reel is required. The following are the messages produced.

a. DISMOUNT REEL #XXXXX THEN MOUNT REEL NUMBER YYYYY ON ZZZZZ

   In this case, XXXXX is the old reel number, YYYYY is the new reel number, and ZZZZZ is the tape drive ID.

   If the operator fails to mount the new tape, the above message will be repeated three times, after which the program will terminate, and all reports produced.

b. IS TAPE XXXXX MOUNTED ON DRIVE ID YYYYY (Y/N)

   In this case, XXXXX is the tape number being requested for mounting and YYYYY is the tape drive ID.

   This message occurs when the data reduction program finds the wrong tape has been mounted (by comparing internally generated tape labels). If the operator answers N, the message in (c) below is produced. If the operator answers Y, the data reduction program will terminate and all reports will be produced. In this case, the data reduction program is unable to process the tape. Even though the operator is mounting the

correct tape, the internal label on the new tape does not match that being requested by the old tape. The user should check the data collection session to insure that the operator did not respond with an incorrect tape number during multireel change.

After entering the Y or N, the operator will need to hit the EOM key twice in order for the response to be transmitted.

c. WRONG REEL JUST MOUNTED, DISMOUNT AND MOUNT REEL XXXXX ON ZZZZZ

In this case, XXXXX is the new reel number, and ZZZZZ is the tape drive ID.

d. CAN TAPE XXXXX BE MOUNTED ON DRIVE YYYYY (Y/N)

In this case, XXXXX is the new desired reel and YYYYY is the tape drive ID.

If the operator fails to answer this message it will be repeated until he responds with a "Y" for YES or "N" for NO. If he types in "Y", then message (a) will be repeated. If the types in "N", then the program will be terminated and all reports will be produced.

10.9 Tape Error Aborts

During the course of processing it is possible that the operator will be required to abort the data reduction program due to an irrecoverable tape error. If such a condition occurs, the operator should abort the job with a "U" abort. This will allow the data reduction program to enter its wrap-up code processing and produce all reports generated prior to the tape error.

This page intentionally left blank

SECTION 11. CENTRAL PROCESSING UNIT AND TAPE REDUCTION PROGRAM (CPUTRP)

11.1 Introduction

The Central Processing Unit and Tape Reduction Program (CPUTRP) is a FORTRAN program that sequentially processes the data recorded on tape by the CPU Monitor and the Tape Monitor of the General Monitor Collector (GMC). It produces a number of reports depicting the usage of the CPUs or the usage of the tape subsystem during the monitoring period. A list of these reports is found in table 11-1 and report descriptions are presented in subsection 11.5.

There are two inputs to the CPUTRP. The first is the data tape produced by the CPU Monitor and/or Tape Monitor in the General Monitor Collector. The second input is a set of report option control cards used to alter the reports in some way other than standard default. The various user input options and their formats are described in subsection 11.6. The actual reports produced by the CPUTRP are described in subsection 11.5.

11.2 Data Collection Methodology

The CPUM in the General Monitor Collector will create its own direct transfer trace (type 70) in order to collect data sufficient to analyze the utilization of the Central Processing Units. The method for generating this direct transfer trace is described in subsection 5.2.3 and the formats for the CPUM generated records used by the CPUTRP are described in subsection 5.4.4.

The Tape Monitor in the General Monitor Collector processes GCOS trace types 50, 51 and 52, and collects information to monitor the usage of the tape subsystem. The information collected on the occurrence of the above traces enables the CPUTRP to identify the jobs using tapes, which drives are used, how long a job is delayed due to nonavailability of tape drives, and the length of time a job is allocated to a given drive.

11.3 Analytical Methodology

There is no special analytical procedures used in this program. The program merely reports on the usage of the CPU and tape subsystem as it is reported by the General Monitor Collector.

11.4 Data Reduction Methodology

The CPUTRP is the only reduction program that actually produces reports from the data gathered by two different monitors (CPU and Tape Monitors). Therefore, a procedure needed to be developed whereby the user could specify which set of reports he desired, or if desired, allow him to produce the set of reports from each monitor. This capability could result in a given set of tapes needing to be analyzed as many as two times within a given run. In order to manage this dual monitor reporting capability, a more complex user interface was required, then previously

Table 11-1. Central Processing Unit and Tape Reduction Reports (Part 1 of 2)

CPU Reports:

a. A periodic tabular report which shows the cumulative CPU utilization by various program categories (default period is 10 minutes) (ID #0).

b. An integer valued histogram of the number of system activities in the CPU queue (ID #1).

c. An integer valued histogram of the number of user activities in the CPU queue (ID #2).

d. A real valued histogram of the CPU burst length for user activities (ID #3).

e. A real valued histogram of the CPU burst length for all activities (ID #4).

f. An ingeter valued histogram of the number of system activities with outstanding I/O (ID #5).

g. An integer valued histogram of the number of user activities with outstanding I/O (ID# 6).

h. An integer valued histogram of the number of system activities with CPU-I/O overlap (ID #7).

i. An integer valued histogram of the number of user activites with CPU-I/O overlap (ID #8).

j. An ingeter valued histogram of the number of inactive activities in core (ID #9).

k. A periodic plot of the CPU idle time (default period is 10 minutes) (ID #10).

k1. A periodic tabular report of WIN CPU usage (default period is 10 minutes) (ID #12).

Tape Reports:

l. An integer valued histogram of the number of tape drives in use (time corrected) (ID #11).

m. A tabular report which describes, for each activity that used tapes, the device and channel utilization and the delay time waiting drives (no report ID # assigned).

Table 11-1. (Part 2 of 2)

Execution Reports:

n. A report which provides an overview of the data reduction - it describes the initial and final data tapes, the card input options and user selected time frames as they occur (no report ID # assigned).

o. A report which shows errors detected by the tape handler, and, if selected, debug output (no report ID # assigned).

p. A report which shows errors detected by program modules other than the tape handler (no report ID # assigned).

used by the other data reduction programs. This interface will be described in subsection 11.6.

11.5 CPUTRP Output

Output is divided, conceptually, into three parts - Execution and Error Reports, CPU Reduction Reports, and Tape Reduction Reports. These categories are shown in table 11-1, and further described below. An example of each report is displayed, and a simple explanation of how it was derived from the data is given.

11.5.1 Execution and Error Reports (Files 6, 7 and 8). These reports are written to three files: codes 6, 7 and 8. On file code 8, the user will find a printout containing processing or execution information - what the CPU and Tape Reduction Program found on the data tapes. Included in this information is the following:

- o A list of the monitors in execution during the GMC data collection.
- o An echo of the user input options, and the program's interpretation of them.
- o The time, date, tape number and RCSR clock at the beginning of collection.
- o If the timeframe option is used, a report of when the various timeframes were reached.
- o A count of the traces reduced within each timeframe option.
- o If a reduction period exceeded 9+ hours, an indication that a 35-bit internal clock overflowed (no error implied).
- o The time, date, tape number and RSCR clock at end of data collection, but only if a termination trace is processed.
- o When the NEW option is user selected, the items above are repeated on a new page.
- o Version number - The software that is compatible with this documentation should indicate VERSION 7.2-10.64, 12 March 1982.

A sample of this report is shown in figure 11-1.

Errors, except for tape handler errors, are listed on file code 6. Any such occurrence is of concern to C751 and should be reported for interpretation and corrective action (202-695-0856). The occurrence of errors will, as a rule, invalidate the run.

All tape handler messages, including tape error messages, are found on file code 7. The following messages are of informative value and are generally self explanatory.

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 Mar 1982

     ACTIVE MONITORS:  ****  ****  CPUM  TM    CM    ****  ****  ****  ****  ****  ****  ****

     DATA COLLECTION BEGAN WITH TAPE D0020 AT 11:44:41 ON 82-03-15,
     RSCRA/Q WERE  000000000000 731542120046

CARD INPUT IS INTERPRETED AS FOLLOWS:

 1: HPRINT(1) CPRINT(300)
     HISTOGRAM REPETITION PERIOD IS 1          SECONDS MINIMUM.
     CPU REPORT REPETITION PERIOD IS NOMINALLY 300        SECONDS.

 2: NEW(D0020)
     TAPE D0020  WILL LEAD OFF A FOLLOWING REDUCTION.

      REDUCED         275  T70   TRACES.

     DATA COLLECTION ENDED WITH TAPE D0020 AT 11:56:48 ON 82-03-15
     RSCRA/Q WERE  000000000000 737066771640
```

Figure 11-1. Sample Execution Report

- "MOUNTING ANOTHER REEL #..."

- "END REACHED IN NXTREC AT RCDCNT ..."
  Explanation: A tape or operator error forced the tape handler to treat the condition as an end-of-file. This message may be preceded by the following

- "ERROR ON THE TAPE READ"

- "TAPE MOUNTED APPEARS INCORRECT BUT IS NEW ... PROCESSING WILL CONTINUE ..."
  Explanation: A newly mounted continuation reel does not conform to continuation conventions, but is also not positively incorrect. The run is probably invalid.

- "INCORRECT TAPE MOUNTED 3 TIMES OR NEXT TAPE CANNOT BE READ. RUN ENDED".
  Explanation: A newly mounted continuation reel is positively incorrect. This will be preceded by

- "WRONG TAPE MOUNTED. WANTED ..."

- "JULIAN DATES DO NOT AGREE. RUN ENDED"
  Explanation: A new physical record bears an incorrect Julian date. This event may result from re-using an old GMC data tape in another collection run in which GMC termination was improper or incomplete.

- "GMFEXC FOUND END OF TAPE ON FIRST READ"

- "GMFEXC ERROR: FIRST RECORD IS IN ERROR OR WRONG TAPE MOUNTED. PHYSICAL RECORD DUMPED".
  Explanation: The occurrence of this message is of concern to C751 only if there was no tape mounting or tape number confusion. This may be preceded by

- "GMFEXC ERROR: ASKED FOR TAPE #... GOT ..."
  Explanation: The NEW option was used, and the user specified tape number does not agree with the number found on the NEW tape.

All other tape handler messages are of concern to C751 and should be reported for correction.

Debug output, when selected, shares file code 7 with the tape handler.

11.5.2 Central Processing Unit Monitor Reports. The CPU title page is printed to file code 14, immediately ahead of any histograms. The title page contains a summary of the systems configuration, the time reduction effectively started and stopped, as well as identifying the system which was monitored and the tape numbers containing the data set.

The next several lines of output describe the overhead of all GMF monitors that were active during data collection. The monitor name is given, its CPU time in seconds, and its overhead as a function of total processor power. The GMF executive overhead is separated from the actual monitors and is listed as "EXEC". The monitor "NAME" is an area of code within the Mass Store Monitor and even though listed separately, it is also included under the monitor "MSM". The monitor "FMS" is also an area of code within the Mass Store Monitor, but in this case it has not been included under the monitor "MSM". Monitor "CM" describes the processor overhead of subroutine T4 (terminate processing) and subroutine T22 (start I/O processing). Monitor "MSM" describes the processor overhead of subroutine T7 (connect processing). Therefore, if the Channel Monitor was active, but the Mass Store Monitor was not, this report will list both "CM", "MSM" and "FMS" monitors. If both the Channel and Mass Store Monitors were active, then the combined overhead of both monitors can be found by the same sum above. For purposes of this report, percent overhead is computed as (CPU time used by monitor)/(total CPU time) x (number of processors).

If a termination record is not reduced for any reason, the lines describing monitor overhead will not be printed. Figure 11-2 provides a sample report.

11.5.2.1 <u>Number of System Activities/User Activities in the CPU Queue (File 14).</u> Figures 11-3 and 11-4 (items B and C of table 11-1) show sample histograms of how busy the CPU queues were and, inferentially, whether or not a particular work load was I/O or CPU bound. They indicate how many system activities/user activities were using or waiting for a processor at the time the samples were taken. The count includes activities with CPU-I/O overlap.

Note: An activity is a system activity if it is privileged and if it has no J* file for SYSOUT.

All histograms produced by the CPUTRP are interpreted in the following manner:

- o In the INDIV NUMBER column, the histogram displays the number of occurrences of a particular event. The particular event being evaluated is represented by the figures in column 5. Therefore, in figure 11-3 we see that 231 times the CPU queue had a length of 0, while 44 times the queue length was 1.

- o In the INDIV PROB. column, the histogram displays the probability that a given event will occur. Therefore, there is an 84% probability that the queue length was 0; i.e., 84% of the time there was no queue, while 16% of the time the queue length was 1.

- o The CUMUL NUMBER and CUMUL PROB. columns are merely the cumulative probability distribution of the histogram. In figure 11-5, we find that 40% of all CPU bursts have a duration of 6ms or less while 96.5% of all CPU bursts have a duration of 12ms or less.

CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982

```
*****************************************************************************************
*****************************************************************************************
*****                                                                               *****
*****                                                                               *****
*****                                                                               *****
*****                ***** T H E   C P U   A N D   T A P E   M O N I T O R *****    *****
*****                                                                               *****
*****                                                                               *****
*****                                                                               *****
***** MONITORING ON 82-03-15 STARTED AT 11:44:41 AND COMPLETED AT 11:56:47 FOR A TOTAL TIME OF 0.20 HOURS *****
*****                   ON SYSTEM NMCC2  RUNNING W64000 ON TAPE D0020               *****
*****                                                                               *****
*****                                                                               *****
*****                                                                               *****
*****                  THE SYSTEMS CONFIGURATION CONSISTED OF:                      *****
*****                                                                               *****
*****                          2 - 6680  CENTRAL PROCESSORS                         *****
*****                                                                               *****
*****                                                                               *****
*****           MONITOR OVERHEAD  -  MONITOR    TIME(SEC)    % OVERHEAD             *****
*****                                -------    ---------    ----------             *****
*****                                 EXEC         47           3.26                *****
*****                                 CPU          47           3.26                *****
*****                                -------    ---------    ----------             *****
*****                                 TOTAL        94           6.52                *****
*****                                                                               *****
*****                                                                               *****
*****                                                                               *****
*****************************************************************************************
*****************************************************************************************
```

Figure 11-2. CPU Title Page

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982

                    DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:44:41 ON 82-03-15

                          NUMBER OF SYSTEM ACTIVITIES IN THE CPU QUEUE

  INDIV.   CUMUL.   CUMUL.   INDIV.   NUMBER          PERCENT OF PROBABILITY OF OCCURRENCE          REPORT
  NUMBER   NUMBER   PROB.    PROB.    QUEUED   00   10   20   30   40   50   60   70   80   90   100     1
                                                I....I....I....I....I....I....I....I....I....I....I
   231      231     0.840    0.840     0-   0  IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    44      275     0.160    0.160     1-   1  IXXXXXXXX

   275 ENTRIES TOTAL    AVERAGE =    0.16000    VARIANCE =    0.134    STANDARD DEVIATION =    0.367
```

Figure 11-3. Number of System Activities in the CPU Queue

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982

                DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:44:41 ON 82-03-15

                          NUMBER OF USER ACTIVITIES IN THE CPU QUEUE

  INDIV.   CUMUL.   CUMUL.   INDIV.   NUMBER        PERCENT OF PROBABILITY OF OCCURRENCE            REPORT
  NUMBER   NUMBER   PROB.    PROB.    QUEUED  00   10   20   30   40   50   60   70   80   90   100      2
                                              I....I....I....I....I....I....I....I....I....I....I
   248      248     0.902    0.902     0-   0 IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    27      275     1.000    0.098     1-   1 IXXXXX

   275 ENTRIES TOTAL    AVERAGE =    0.09818    VARIANCE =    0.089    STANDARD DEVIATION =    0.298
```

Figure 11-4. Number of User Activities in the CPU Queue

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982

                       DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:44:41 ON 82-03-15

                             CPU BURST DISTRIBUTION FOR USER ACTIVITIES ONLY

   INDIV.   CUMUL.   CUMUL.   INDIV.   MILLI-        PERCENT OF PROBABILITY OF OCCURRENCE          REPORT
   NUMBER   NUMBER   PROB.    PROB.    SECOND  00   05   10   15   20   25   30   35   40   45   50      3
                                                I....I....I....I....I....I....I....I....I....I....I
     85       85     0.020    0.020     3.000   IXX
    144      229     0.053    0.033     4.500   IXXX
   1511     1740     0.404    0.351     6.000   IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    703     2443     0.567    0.163     7.500   IXXXXXXXXXXXXXXXX
   1593     4036     0.937    0.370     9.000   IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     75     4111     0.954    0.017    10.500   IXX
     47     4158     0.965    0.011    12.000   IX
    150     4308     1.000    0.035    13.500   IXXX

   4308 ENTRIES TOTAL    AVERAGE =    6.91398    VARIANCE =    3.543    STANDARD DEVIATION =    1.882
```

Figure 11-5. CPU Burst Length Distribution for User Activities

- The last line of the histogram provides some standard statistical output such as average, variance and standard deviations.

11.5.2.2 CPU Burst Distribution for User Activities/All Activities (File 14). Figures 11-5 and 11-6 (items D and E of table 11-1) show sample histograms of the CPU burst length distribution for user activities/all activities. They provide a measure of how long an activity held a processor before relinquish or interrupt.

WARNING: Each report is not a true histogram of individual burst lengths but is one of burst averages over a sampling period. For example, figure 11-6 shows 37062 bursts, but only 275 samples were taken. Each sample provided a count of intersample bursts and the accumulated burst time. For each sample, the histogram was charted as though each burst had the same length, namely, the average intersample burst length equals the accumulated-burst-time divided by count-of-bursts.

11.5.2.3 Number of System Activities/User Activities in Core with Outstanding I/O (File 14). These two histogram reports (items F and G of table 11-1) show how many system activities/user activities were in core with outstanding I/O. Included in this count are those activities with CPU-I/O overlap. See figures 11-7 and 11-8 for examples.

11.5.2.4 Number of System Activities/User Activities in Core with CPU-I/O Overlap (File 14). These two histograms (items H and I of table 11-1), samples of which are given in figures 11-9 and 11-10, show how many system activities/user activities were both in a CPU queue and had outstanding I/O at the same time. These histograms, together with those described in subsections 11.5.2.1 through 11.5.2.3 provide an understanding of the CPU-I/O balance of a particular workload at the times the samples were taken.

11.5.2.5 Number of Inactive Activities in Core (File 14). This histogram report (item J of table 11-1), figure 11-11, shows the count of activities in core that were neither eligible for CPU service nor were waiting I/O at the time the samples were taken.

11.5.2.6 CPU Time Reports (File 10). This tabular report is produced every ten minutes (default period) of elapsed time. The first line indicates how many seconds have elapsed in the analysis, the total CPU time that has elapsed (total elapsed time x the average number of processors available through this period), the system id, time of day and date. The amount of total CPU time is adjusted for any processors that have been released.

The next block of print gives the accumulated CPU time for each system program, for TSS, TRAX, WIN, and for all slave activities (presented as a single figure under the heading USER). The CPU time used by the slave portion of the GMC collector is shown separately (heading MONITR).

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982

                         DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:44:41 ON 82-03-15

                                   CPU BURST DISTRIBUTION FOR ALL ACTIVITIES

    INDIV.    CUMUL.    CUMUL.    INDIV.    MILLI-       PERCENT OF PROBABILITY OF OCCURRENCE          REPOR
    NUMBER    NUMBER    PROB.     PROB.     SECOND   00   10   20   30   40   50   60   70   80   90   100      4
                                                     I....I....I....I....I....I....I....I....I....I....I
      707       707     0.019     0.019      1.500   IX
      574      1281     0.035     0.015      3.000   IX
    27974     29255     0.789     0.755      4.500   IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
     3979     33234     0.897     0.107      6.000   IXXXXX
     1698     34932     0.943     0.046      7.500   IXX
     1834     36766     0.992     0.049      9.000   IXX
       94     36860     0.995     0.003     10.500   I
       48     36908     0.996     0.001     12.000   I
      152     37060     1.000     0.004     13.500   I
        1     37061     1.000     0.000     15.000   I
        1     37062     1.000     0.000     16.500   I

    37062 ENTRIES TOTAL      AVERAGE =    4.24950    VARIANCE =    2.104    STANDARD DEVIATION =    1.451
```

Figure 11-6. CPU Burst Length Distribution for All Activities

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982

                    DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:44:41 ON 82-03-15

                      NUMBER OF SYSTEM ACTIVITIES IN CORE WITH OUTSTANDING I/O

   INDIV.   CUMUL.   CUMUL.   INDIV.   NUMBER        PERCENT OF PROBABILITY OF OCCURRENCE          REPORT
   NUMBER   NUMBER   PROB.    PROB.    WITH     00   10   20   30   40   50   60   70   80   90   100     5
                                                 I....I....I....I....I....I....I....I....I....I....I
      9        9     0.033    0.033     3-   3   IXX
    146      155     0.564    0.531     4-   4   IXXXXXXXXXXXXXXXXXXXXXXXXXXX
    106      261     0.949    0.385     5-   5   IXXXXXXXXXXXXXXXXXXX
     13      274     0.996    0.047     6-   6   IXX
      1      275     1.000    0.004     7-   7   I

    275 ENTRIES TOTAL       AVERAGE =    4.45818    VARIANCE =     0.430    STANDARD DEVIATION =    0.656
```

Figure 11-7. Number of System Activities in Core with Outstanding I/O

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982

               DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:44:41 ON 82-03-15

                    NUMBER OF USER ACTIVITIES IN CORE WITH OUTSTANDING I/O

  INDIV.  CUMUL.  CUMUL.  INDIV.  NUMBER        PERCENT OF PROBABILITY OF OCCURRENCE          REPORT
  NUMBER  NUMBER  PROB.   PROB.   WITH     00   10   20   30   40   50   60   70   80   90   100     6
                                            I....I....I....I....I....I....I....I....I....I....I
   234     234    0.851   0.851    1-   1   IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    38     272    0.989   0.138    2-   2   IXXXXXXX
     2     275    0.996   0.007    3-   3   I
     1     275    1.000   0.004    4-   4   I

  275 ENTRIES TOTAL     AVERAGE =    1.16364    VARIANCE =    0.173    STANDARD DEVIATION =    0.416
```

Figure 11-8. Number of User Activities in Core with Outstanding I/O

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982

                    DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:44:41 ON 82-03-15

                       NUMBER OF SYSTEM ACTIVITIES IN CORE WITH CPU-I/O OVERLAP

  INDIV.    CUMUL.    CUMUL.    INDIV.    NUMBER         PERCENT OF PROBABILITY OF OCCURRENCE              REPORT
  NUMBER    NUMBER    PROB.     PROB.     WITH      00   10   20   30   40   50   60   70   80   90   100      7
                                                     I....I....I....I....I....I....I....I....I....I....I
   236       236      0.858     0.858      0-   0   IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
    39       275      1.000     0.142      1-   1   IXXXXXXX

   275 ENTRIES TOTAL        AVERAGE =    0.14182     VARIANCE =     0.122     STANDARD DEVIATION =   0.349
```

Figure 11-9. Number of System Activities in Core with CPU-I/O Overlap

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982

                        DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:44:41 ON 82-03-15

                            NUMBER OF USER ACTIVITIES IN CORE WITH CPU-I/O OVERLAP

    INDIV.    CUMUL.    CUMUL.    INDIV.    NUMBER          PERCENT OF PROBABILITY OF OCCURRENCE               REPORT
    NUMBER    NUMBER    PROB.     PROB.     WITH      00   10   20   30   40   50   60   70   80   90   100        8
                                                       I....I....I....I....I....I....I....I....I....I....I
     257       257      0.935     0.935      0-    0   IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
      18       275      1.000     0.065      1-    1   IXXX

     275 ENTRIES TOTAL        AVERAGE =    0.06545     VARIANCE =    0.061     STANDARD DEVIATION =    0.247
```

Figure 11-10. Number of User Activities in Core with CPU-I/O Overlap

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982

                    DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:44:41 ON 82-03-15

                              NUMBER OF NON-ACTIVE ACTIVITIES IN CORE

INDIV.   CUMUL.   CUMUL.   INDIV.   NUMBER         PERCENT OF PROBABILITY OF OCCURRENCE               REPORT
NUMBER   NUMBER   PROB.    PROB.    INACTV   00   10   20   30   40   50   60   70   80   90  100        9
                                              I....I....I....I....I....I....I....I....I....I....I
   1        1     0.004    0.004     7-   7   I
  13       14     0.051    0.047     8-   8   IXX
  24       38     0.138    0.087     9-   9   IXXXX
  99      137     0.498    0.360    10-  10   IXXXXXXXXXXXXXXXXXX
 138      275     1.000    0.502    11-  11   IXXXXXXXXXXXXXXXXXXXXXXXXX

 275 ENTRIES TOTAL         AVERAGE =   10.30909     VARIANCE =    0.715     STANDARD DEVIATION =    0.846
```

Figure 11-11. *Number of Inactive Activities in Core*

The third set of print provides, for each copy of Time Sharing (TSS), the CPU time attributable to the execution phase and to the subdispatch phase. In addition, for each copy of TSS, the average service time is also presented. This figure is represented in clock pulses (1/64ms). This figure represents the average amount of CPU time used by TSS whenever it received control of the processor. By tracking this figure, it is possible to see if bad periods of TSS response coincide with periods of time when TSS was receiving inadequate time slices of CPU service. The service time is calculated by taking the total CPU time accumulated by TSS and dividing it by the total number of CPU bursts accumulated by TSS.

The next block of print shows the amount of overhead, idle and gate-loop time accumulated by each processor and by total. Gate-loop data is not applicable in a single processor environment. Gate loop time is that amount of time a processor is locked from executing because another processor has locked a required table or blocked a given area of code. In a multiprocessor environment, there are many instances where one processor is required to alter the values in a given table. While these values are being changed, the system wants to ensure that another processor does not reference the table, while it is in the midst of being changed. To prevent this from happening, the system will lock the table while it is in the midst of being altered. If a second processor desires to reference a locked table, it is required to execute a CPU "dead" loop while it waits for the table to be opened. The GLOOP statistics display the amount of such loop time executed by each processor. This value will not be reported for a single processor environment but should appear for any multiprocessor environment where the software release was WW7.2/4JS. If this data is not reported, it indicates a problem with the GMF collector and CCTC should be contacted.

The final block of print is a percentage breakdown of CPU usage into the categories SYSTEM, TSS, TRAX, WIN, USER, and IDLE; also shown are the percentage of gate-loop time relative to processor busy time and the time corrected number of processors in use. These figures are printed both for the current 10-minute interval and for the total current reduction interval. This allows the user to track when peak usage of CPU power is occurring and what portion of the system is using this power. Figure 11-12 provides a sample of this report.

Notes: (1) SYSTEM time includes CPU time accumulated in the "functions" OVERHEAD, MISCELLANEOUS, CALC, PALC, SYOT, RTIN, TDS, LOGN, FSYS, DMTEX and MONITR. The time attributable to WIN, TSS and TRAX is neither SYSTEM nor USER. (2) The definition of overhead time is the time spent in the interrupt handler, the dispatcher and the SWAP processor, plus all gate-loop time. (3) It should be noted that the percentage figures are based on total CPU power and therefore add up to 100% (excluding the gate-loop percentage). In order to determine the "amount of a processor" required or used by a given function, it would be necessary to multiply the percentage figure for the function by the time corrected number of processors in use.

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982

ELAPSED (PROCESSOR) TIME IS      301 (    602) SECONDS ON SYSTEM NMCC2 AT TIME 11:49:42 ON 82-03-15

CPU TIME USED THUS FAR IN HUNDREDTHS SECOND
   OHEAD    MISC    CALC    PALC    SYOT    RTIN    T/DS    LOGN    FSYS   DMTEX     TSS    TRAX     WIN    USER  MONITR
    5415      56      99     289      79      18    6076       0       0       0     722       0     323     946      75

TIME SHARING EXECUTIVE AND SUBDISPATCH IN HUNDREDTHS SECOND         SERVICE TIME IN CLOCK PULSES SINCE BEGINNING OF RUN
                TS1     TS2     TS3     TS4                                    TS1     TS2     TS3     TS4     AVG
EXEC            722       0       0       0                                    320
SUBDIS            0       0       0       0                                     70                             390

OVERHEAD, IDLE, GATE LOOP TIME IN HUNDREDTHS SECOND (GATE LOOP ALSO INCLUDED IN OVERHEAD)
          CPU 1   CPU 2   CPU 3   CPU 4   CPU 5   CPU6   TOTAL
 OHEAD     3401    2014       0       0       0      0    5415
 IDLE     21198   24895       0       0       0      0   46094
 GLOOP STATISTICS NOT COLLECTED OR INCOMPLETE

# CPUS, % SYSTEM CPU,   % TSS CPU,   % TRAX CPU,   % WIN CPU,   % USER CPU,   % IDLE TIME & % GATE LOOP OF BUSY...SINCE
  2.00            20            1             0            0             1              76              0     RUN START
  2.00            20            1             0            0             1              76              0    LAST PRINT
```

Figure 11-12. CPU Time Report

Figure 11-13 shows the CPU report when special SNUMBs were selected for monitoring. In this case it was desired to monitor jobs "AAAAA", "MMMMM", and "FIVE ". All other information is identical to that described in figure 11-12. The CPU times listed for special SNUMBs are also included in the appropriate category under the heading "CPU TIME USED THUS FAR...".

11.5.2.7 CPU Plot of Percent Idle (File 31). This plot report shows the percentage of CPU power that is idle during each 10-minute (default period) interval. The data is taken directly from the CPU Time Report described in subsection 11.5.2.6. One horizontal line is output for every CPU Time Report table. The horizontal line represents one increment on the X-axis and it "paints" one datum of percent idle and the change of that datum since it was last plotted. Every 10th line also displays the current time of day. By the nature of the printing mechanism, an ordinate position is a cell, a range of values. The cell width is specified by a DELTA value given in the heading. The plot contains a heading line giving the system id, starting time of reduction and the date. It also contains the report title, and identifying mark, "A" here, of the curve, and the DELTA value. A plot summary, if not user deactivated, follows each plot. Following the summary is the overall system idle percentage in three intervals; zero to 25% idle, 25 to 50% idle and 50 to 100?% idle. A final line shows the plot interval in seconds (default is 600 seconds). Figure 11-14 is a sample of this plot.

11.5.2.8 WIN Report. This report is the only CPU report that is not produced by default and must specifically be requested with the use of the "ON" option. It will be generated under the same time interval control as is used for the CPU Time Report (subsection 11.5.2.6) (default value every 10 minutes). Figure 11-15 is a sample of this report (no WIN software was active at the time this sample report was generated). For each WIN program, a single line of information is presented. This line indicates the total amount of CPU time accumulated by the program during the specified time interval, the number of CPU bursts accumulated during the time interval and the rate (bursts/sec) at which the bursts were generated. This report can be used to track those periods of time when WIN programs were using excessive CPU time or, on the other hand, were being denied CPU service.

11.5.3 Tape Monitor Reduction Reports. The tape reduction title page is identical to the CPU reduction title page (see subsection 11.5.2), except that the configuration described is pertinent to the tape subsystem. Shown are the channel number, the IOM number, the number of drives configured to the channel, the type of drive and whether the drives are cross-barred. The data shown is the configuration as presented in the boot deck. If any drives have been taken off line for maintenance or repair, it will not be reflected. The title page precedes any histograms; an example is presented as figure 11-16. It is written to file 14.

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982

ELAPSED (PROCESSOR) TIME IS      30 (     60) SECONDS ON SYSTEM NMCC2 AT TIME 11:45:11 ON 82-03-15

CPU TIME USED THUS FAR IN HUNDREDTHS SECOND
   OHEAD    MISC    CALC    PALC    SYOT    RTIN    T/DS    LOGN    FSYS   DMTEX     TSS    TRAX     WIN    USER  MONITR
     236       0       7      25       0       0       0       0       0       0     135       0      31      62      27


TIME SHARING EXECUTIVE AND SUBDISPATCH IN HUNDREDTHS SECOND        SERVICE TIME IN CLOCK PULSES SINCE BEGINNING OF RUN
               TS1     TS2     TS3     TS4                                  •     TS1     TS2     TS3     TS4     AVG
EXEC           135       0       0       0                                        320
SUBDIS           0       0       0       0                                         70                             390


CPU TIME USED BY SPECIAL SNUMBS IN HUNDREDTHS SECOND
          AAAAA          MMMMM          FIVE
              0             41            20


OVERHEAD, IDLE, GATE LOOP TIME IN HUNDREDTHS SECOND (GATE LOOP ALSO INCLUDED IN OVERHEAD)
         CPU 1   CPU 2   CPU 3   CPU 4   CPU 5   CPU6   TOTAL
 OHEAD     175      61       0       0       0      0     236
 IDLE     2781    2649       0       0       0      0    5430
 GLOOP STATISTICS NOT COLLECTED OR INCOMPLETE


# CPUS, % SYSTEM CPU,     % TSS CPU,    % TRAX CPU,    % WIN CPU,    % USER CPU,    % IDLE TIME & % GATE LOOP OF BUSY...SINCE
  2.00              4             2              0             0              1                 90            0      RUN START
  2.00              4             2              0             0              1                 90            0     LAST PRINT
```

Figure 11-13. CPU Time Report with Special Snumbs

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982

                            DISTRIBUTION COLLECTION ON SYSTEM NMCC2 AT 11:44:41 ON 82-03-15


                                         CPU UTILIZATION OF SYSTEM/USER IDLE                                PLOT-1

 DELTA=    7.9365E-01    A=IDLE

TIME OF DAY                                                 % IDLE

Y---------Y---------Y---------Y---------Y---------Y---------Y---------Y---------Y---------Y---------Y---------Y---------Y
X 11:45:11.14                                                                                                   A
I                                                                                                              AA
I                                                                                                     AAAAAAAAAA
I                                                                                                     AAAAAAA
I                                                                                   AAAAAAAAAAAAAAAAAAAAAAAAA
I                                                                                   A
I                                                                                  AA
I                                                                                  AA
I                                                                                  AA
X 11:49:53.28                                                                      AAA
I                                                                                   AA
I                                                                                AAA
I                                                                                AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
I                                                                                                              AAAAA

    CURVE         MINIMUM          MAXIMUM
    IDLE          0.6600E 02       0.9300E 02

                          0.  %  25% IDLE      0.  %  = 25% AND  = 50% IDLE      100.00%   50% IDLE

                         THE PRINT PERIOD FOR THIS PLOT IS NOMINALLY          30 SECONDS
```

Figure 11-14. CPU Plot of Percent Idle

DISTRIBUTION COLLECTED ON SYSTEM DSCC1 AT 1005:54.955 TUE 82-01-19. INITIAL GMF TAPE # 1182

WIN REPORT -- TIME IN HUNDREDTHS SECONDS; RATE, 1/SEC

	NCP			TELNET			FTS			TLCF		
TIME	CPUTIME	BURSTS	BURST-RATE	CPUTIME	BURSTS	BURST-RATE	CPUTIME	BURSTS	BURST-RATE	CPUTIME	BURSTS	BURST-RATE
1015:54.385	0	0	0.	0	0	0.	0	0	0.	0	0	0.
1025:56.385	0	0	0.	0	0	0.	0	0	0.	0	0	0.
1035:58.074	0	0	0.	0	0	0.	0	0	0.	0	0	0.
1045:54.581	0	0	0.	0	0	0.	0	0	0.	0	0	0.
1055:59.947	0	0	0.	0	0	0.	0	0	0.	0	0	0.
1106:01.044	0	0	0.	0	0	0.	0	0	0.	0	0	0.
1116:03.416	0	0	0.	0	0	0.	0	0	0.	0	0	0.
1121:59.169	0	0	0.	0	0	0.	0	0	0.	0	0	0.

Figure 11-15. WIN Report

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982

**************************************************************************************************
**************************************************************************************************
*****                                                                                        *****
*****                                                                                        *****
*****                                                                                        *****
*****                   ***** T H E   C P U   A N D   T A P E   M O N I T O R *****          *****
*****                                                                                        *****
*****                                                                                        *****
*****                                                                                        *****
***** MONITORING ON 82-03-15 STARTED AT 11:44:41 AND COMPLETED AT 11:56:47 FOR A TOTAL TIME OF 0.20 HOURS *****
*****                    ON SYSTEM NMCC2  RUNNING W64000 ON TAPE D0020                        *****
*****                                                                                        *****
*****                                                                                        *****
*****                                                                                        *****
*****                    THE SYSTEMS CONFIGURATION CONSISTED OF:                             *****
*****                                                                                        *****
*****                                                                                        *****
*****         CHANNEL    IOM     # DEVICES       TYPE             SCT ADDR(SAME=XBAR)        *****
*****           18        0          6       9 TRACK TYPE                1936                *****
*****           19        0          6       9 TRACK TYPE                1960                *****
*****           24        1          6       9 TRACK TYPE                2032                *****
*****                                                                                        *****
*****                                                                                        *****
*****               MONITOR OVERHEAD  -  MONITOR     TIME(SEC)     % OVERHEAD                *****
*****                                    -------     ---------     ----------                *****
*****                                     EXEC           47           3.26                   *****
*****                                     TAPE            1           0.01                   *****
*****                                    -------     ---------     ----------                *****
*****                                     TOTAL          48           3.27                   *****
*****                                                                                        *****
*****                                                                                        *****
*****                                                                                        *****
**************************************************************************************************
**************************************************************************************************
```

Figure 11-16. Tape Reduction Title Page

11.5.3.1 Number of Tape Drives in Use (Time Corrected) (File 14). A histogram report, seen as figure 11-17, shows the number of tape drives in use at the sampling epoch. The data are corrected for the inter-sample period, so that the figures listed under the heading "INDIV. PROB." correctly represent the fraction of reduction time the corresponding "NUMBER (of) DRIVES" were in use.

11.5.3.2 Tape Activity Report (File 13). This tabular report is made for each activity of a job that used tapes. For each activity of a job, the tapes used by that activity are described by type, unit number, and channel number. The report also presents how long the activity was delayed in peripheral allocation and how many drives it was waiting for. The final print tells how many drives were in use when the activity started and how many were in use when it ended. At the right margin of the report are two columns of numbers. The first column is the numerical sequence in which the activities started, and the second column is the numerical sequence in which they terminated. Refer to figure 11-18 for a sample report.

11.5.3.3 Tape Status Report (File 12). This tabular report may be seen as figure 11-19. It shows the status of all configured tape drives, and is repeated each time an activity was delayed due to unavailability of tape drives. (The first report entry is listed with the initial trace captured by the monitor collector). The reason for the delay, the epoch of the delay and the program number of the activity delayed are printed. As part of the status information, the following is presented: IOM-channel number, unit number, released or not, assigned or not, dedicated or not, used for T&D's or not, number of errors on the device, and the SNUMB of the job using that drive.

11.6 Default Option Alteration

The CPU and Tape Reduction Program uses two inputs. The first is the data tape(s) produced by the GMC. The second input is a set of report option control cards. The various options and their formats are described in the following subsections. Report option control cards are not required if the default options are acceptable to the user.

11.6.1 General Format. The general format for an option request is as follows:

    COMMAND (PARAMETER-LIST)

where COMMAND is a keyword specifying what action is to be taken and (PARAMETER-LIST), if required, provides data to accomplish the action. The COMMAND is interpreted through its sixth character, so the input must match the first six characters of the valid commands described below. Shorter commands must match exactly.

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982

                    DISTRIBUTION COLLECTED ON SYSTEM NMCC2 AT 11:44:41 ON 82-03-15

                           THE TIME CORRECTED NUMBER OF TAPE DRIVES IN USE

  INDIV.   CUMUL.   CUMUL.   INDIV.   NUMBER       PERCENT OF PROBABILITY OF OCCURRENCE              REPORT
  NUMBER   NUMBER   PROB.    PROB.    DRIVES  00   10   20   30   40   50   60   70   80   90   100     10
                                               I....I....I....I....I....I....I....I....I....I....I
 4769030  4769030   1.000    1.000     1-   1  IXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

 4769030 ENTRIES TOTAL       AVERAGE =   1.00000     VARIANCE =    0.     STANDARD DEVIATION =   0.
```

Figure 11-17. Number of Tape Drives in Use (Time Corrected)

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982
   TAPE ACTIVITY REPORT FOR SYSTEM NMCC2 ON 82-03-15 AT 11:44

 TAPES FOR PROG (22)  MUM   ACTIVITY   1        TYPE           UNIT               CHANNEL NUMBER
                                              9 TRACK TAPE        4                   18( 0)
        THIS ACTIVITY HAD NO WAIT TIME


   WHEN ACTIVITY STARTED    1  TAPES WERE IN USE. WHEN IT ENDED    0  TAPES WERE IN USE          1      3
                  ***THIS PROGRAM WAS ACTIVE WHEN MONITOR STARTED
*************************************************************************************************************
```

Figure 11-18. Tape Activity Report

```
CPU AND TAPE REDUCTION, VERSION 7.2 - 10.64, 12 MAR 1982
   TAPE STATUS REPORT FOR SYSTEM NMCC2 ON 82-03-15 AT 11:44
      CHANNEL  UNIT  RLSED  ASGND  DED  T&D  ERRORS  SNUMB        CHANNEL  UNIT  RLSED  ASGND  DED  T&D  ERRORS  SNUMB
       0-18     0     NO     NO    NO   NO      0                  0-18     1     YES    NO    NO   NO      0
       0-18     2     NO     NO    NO   NO      0                  0-18     3     NO     NO    NO   NO      0
       0-18     4     NO     YES   NO   NO     27    MUM           0-18     5     NO     NO    NO   NO      0
       0-19     0     YES    NO    NO   NO      0                  0-19     1     YES    NO    NO   NO      0
       0-19     2     YES    NO    NO   NO      0                  0-19     3     YES    NO    NO   NO      0
       0-19     4     YES    NO    NO   NO      0                  0-19     5     YES    NO    NO   NO      0
       1-24     0     YES    NO    NO   NO      0                  1-24     1     YES    NO    NO   NO      0
       1-24     2     YES    NO    NO   NO      0                  1-24     3     YES    NO    NO   NO      0
       1-24     4     YES    NO    NO   NO      0                  1-24     5     YES    NO    NO   NO      0
       ************************************************************************************************
                     ****PROGRAM NUMBER 18 WAS DELAYED AT 11:53 FOR 2 7 TRACK TAPE
       0-18     0     NO     NO    NO   NO      0                  0-18     1     YES    NO    NO   NO      0
       0-18     2     NO     NO    NO   NO      0                  0-18     3     NO     NO    NO   NO      0
       0-18     4     NO     YES   NO   NO     34    MUM           0-18     5     NO     NO    NO   NO      0
       0-19     0     YES    NO    NO   NO      0                  0-19     1     YES    NO    NO   NO      0
       0-19     2     YES    NO    NO   NO      0                  0-19     3     YES    NO    NO   NO      0
       0-19     4     YES    NO    NO   NO      0                  0-19     5     YES    NO    NO   NO      0
       1-24     0     YES    NO    NO   NO      0                  1-24     1     YES    NO    NO   NO      0
       1-24     2     YES    NO    NO   NO      0                  1-24     3     YES    NO    NO   NO      0
       1-24     4     YES    NO    NO   NO      0                  1-24     5     YES    NO    NO   NO      0
       ************************************************************************************************
```

Figure 11-19. Tape Status Report

Table 11-2. Histogram Default Parameters

REPORT ID	TRAILER FLAG	# INTERVALS	LOW VALUE	INTERVAL SIZE
1	ON	40	0	1
2	ON	40	0	1
3	ON	45	0.0	1.5
4	ON	45	0.0	1.5
5	ON	40	0	1
6	ON	40	0	1
7	ON	40	0	1
8	ON	40	0	1
9	ON	40	0	1
11	ON	40	0	1

Table 11-3. Plot Default Parameters

REPORT ID	# POINTS to PLOT	Y-MINIMUM	Y-MAXIMUM
10	UNLIMITED	0.0	100.0

11.6.1.1 Valid Commands. Eleven commands are recognized by the card input interpreter. The chart below shows each command, the action to be taken, and in parentheses, the default inplications.

- o CPRINT — Print the CPU Time Report and one datum of the CPU Idle Time Plot (items A and K and K1 of table 11-1) at a specified repetition period. (Print every 600 seconds).

- o DEBUG — Activate the debug statements in one or more subroutines. (All debug statements are inactive).

- o HISTOGRAM — Modify a histogram report. (Histogram report parameters are as shown in table 11-2).

- o NEW — Prepare to accept another, or repeat, set of GMC data tapes and another set of option alteration commands for a following reduction run. (Reduction is complete when the current tape(s) are reduced).

- o HPRINT — Print the histograms only if the reduction interval is, at least, a specified minimum. (Print the histograms only if the reduction interval is at least 900 seconds).

- o ON / OFF —
  (1) Turn on/off one or more reports. (All reports are on except the WIN Report (item K1 of table 11-1) (ID 12)).

  (2) Turn on/off the CPU reduction module or the TAPE reduction module but not both. (CPU reduction is on; TAPE reduction, off).

- o PLOT — Modify a plot. (Plot report parameters are as shown in table 11-3).

- o STOP — Stop reduction after processing a specified number of physical tape records. (No limit).

- o TIMEFRAME —
  (1) Accept one to five time windows for overall data reduction or for plot output. (Data reduction and report output are not time limited).

  (2) Accept one to five time windows for debug output. (Debug output is not time limited).

  (3) Treat the receipt of a specified or implied special record as the end of one timeframe and start of another - that is, print the reports and start a new reduction period immediately. (No timeframe action is taken).

- o TITLE — Accept a new title to be printed on all reports as the new banner. ("CPU AND TAPE REDUCTION, VERSION 7.2-10.64, 12 MAR 82" is printed as banner).

11.6.1.2 Parameter List. The parameter list is a sequence of data items separated one from the next by a field of spaces. Any one space in the field may optionally be replaced by a comma or colon. A data item may be an alphanumeric, a quoted string, an integer, a real number or a null. Strings are enclosed in single or double quotes. Real numbers include the standard FORTRAN forms: for example, 12.34, 1234E-2, 1.234+1 are all accepted as the same number. A null is two consecutive commas or colons; it stands for a missing data item and for the separator fields on either side of the missing item.

11.6.1.3 Command Syntax. Each command with its parameter list must be complete on a single card, but more than one command may be placed on each card if spaces separate them. The parameter list may be contiguous with the command keyword or spaces may intervene. The syntax for each command is given in following subsections. The data acronym RID stands for a one or two digit integer specifying the report identification number of the report to be affected. Report identification numbers are shown in table 11-1. The specifications "integer-W", "alphanumeric-X", "real-Y", and "string-Z" require user input of an integer number in a field at most "W" wide, an alphanumeric in a field at most "X" wide, a real number in a field at most "Y" wide and a quoted string in a field at most "Z" wide, respectively. Alphanumerics and strings exceeding the field width are accepted but are truncated to the right. Integers and reals exceeding the specified field width are rejected as illegal data. Integers may not contain a decimal point. Reals must contain a decimal point or an exponent. Reals are limited, for all data input, to a maximum of 14 characters including leading sign, decimal point, and exponent. Reals without exponent are further limited to a maximum of 11 characters including leading sign and decimal point. Data items shorter than the specified field width are entirely acceptable in all commands, but a null item is acceptable only where provided for.

11.6.1.4 General Control Command Syntax. The CPU and Tape Reduction program permits reduction of either the CPU associated traces or the tape subsystem associated traces during one pass over the data tapes. The CPU reduction phase is on, and the tape reduction phase is off, by default. The following commands may be used to exercise general control over the reduction:

- o DEBUG — Activates all debug statements.

- o DEBUG (MODULE-NAME-1,..., MODULE-NAME-N)
  Activates the debug statements in the explicitly named modules, where MODULE-NAME-i is the FORTRAN name given

to the subroutine or function. Only the first six characters are interpreted. The routines currently debuggable are:

CLOCK - keeps the master clock

FIGCHG - examines a reconfiguration record for CPU related change

GETOKE - lexical analysis of card input

LOGREC - gets a logical record meeting reduction requirements

NXTRECRD - tape input handler

RECNFG - gets the initial reconfiguration trace

TIMSET - sets up the array of start-stop times for user specified reduction windows

The one-shot program GMFEXC which reads the initial tape record is executed before card input. It may be debugged by setting program switch word, bit 11 (i.e., ON6).

- HISTOGRAM (RID, TRAILER-FLAG, NUMBER-OF-INTERVALS, LOW-VALUE, INTERVAL-SIZE)
  Turns on the histogram with report identification number RID, integer-2. Print/don't print the histogram summary if TRAILER-FLAG is ON/OFF, alphanumeric-3. The new number of histogram intervals is NUMBER-OF-INTERVALS, integer-3. The new low value and interval size are LOW-VALUE and INTERVAL-SIZE both integer-10 or real-14 according to the type of histogram. (In the current version, the number of intervals may not exceed 50).

The following two options are as above, but without change to the current specification of those parameters not appearing in the list.

- HISTOGRAM (RID,,NUMBER-OF-INTERVALS, LOW-VALUE, INTERVAL-SIZE)
- HISTOGRAM (RID, TRAILER-FLAG)

- NEW (TAPE-NUMBER)
  Flags the reduction program to stop reading card input options and to proceed with data reduction. It also informs the program that another data reduction is to follow, and that the following reduction is to lead

off with the tape number specified by this option (any six characters). For that following reduction, the default options will prevail unless modified by option alteration commands following the NEW command. This command must be the last command on a card (following commands on the same card are lost).

- HPRINT (X) Prints histograms if reduction interval is at least X, integer-10, seconds. Otherwise, the histogram data are lost.

- OFF Turns off all histograms and plots (if any).

- OFF (RID-1,...,RID-n)
  Turns off the reports specified by report identification numbers RID-1,...,RID-n.

For the remaining OFF options, the first two characters of the parameter are necessary and sufficient.

- OFF (PLOTS) Turns off all plots (if any).

- OFF (HISTOGRAMS)
  Turns off all histograms.

- OFF (CPU) Turns off the CPU reduction phase of the program and turns on the TAPE reduction phase.

- OFF (TAPE) Turns off the TAPE reduction phase and turns on the CPU phase. This is the default specification and is not likely to be used, but is included here for completeness.

- ON ON options use the same parameters as those shown for the OFF command, with appropriate reversal of intent. All reports are on by default except the WIN Report (item K1, table 11.1, ID 12) which is off by default and must be turned on with this option.

Note: CPU and tape reduction cannot be done simultaneously. To accomplish both reductions in a single job, use the NEW option and a form of the ON/OFF option: ON(TAPE), for example.

- STOP (X) Stop data reduction after reading X, integer-10, records maximum.

- TIMEFRAME (DEBUG, START TIME, STOP TIME, START TIME, STOP TIME, ...)
  Accepts up to five start/stop pairs, where each component of the pair is a pseudo decimal number (real 7) in the form HHMM.SS where HH is the hour, MM is the

minute and SS is the second. The decimal point must appear on the card, to further delimit the action of debug statements. The limiting action becomes effective as soon as the program determines "what time it is." This command must be accompanied by some form of the DEBUG command or no debug output will be produced. The timeframes are independent of, though not unaffected by, any other user selected timeframes.

- o TITLE (X) Accepts the string X, string-72, as the new banner for all reports. X must begin and end with a quotation mark, single or double, and may contain any FORTRAN acceptable character except the matching quote with which it is delimited.

11.6.1.5 CPU Reduction Command Syntax. In addition to those commands given in section 11.6.1.4, the following are pertinent to the CPU reduction phase.

- o CPRINT (X) Prints the CPU Time Report and one datum of the CPU percent-idle plot every X, integer-10, seconds. The specified period is nominal and the actual period will vary with trace times. This command will not affect the on/off status of these reports.

- o PLOT (RID, NUMBER-OF-POINTS, Y-MINIMUM, Y-MAXIMUM)
  Turns on plot with report identification number RID, integer-2. The new number of points to plot is NUMBER-OF-POINTS, integer-10, maximum. The y-axis of plot is bounded below by Y-MINIMUM, real-14, and above by Y-MAXIMUM, real-14.

The following two options are as above, but without change to the value of those parameters not specified.

- o PLOT (RID, NUMBER-OF-POINTS)
- o PLOT (RID,, Y-MINIMUM, Y-MAXIMUM)

- o TIMEFRAME (RID, START TIME, STOP TIME, START TIME, STOP TIME, ...)
  Turns on report with report identification number RID, integer-2. Sets start and stop times according to the pair
  START TIME, STOP TIME, START TIME, STOP TIME,
  where each component is a pseudo decimal number (real 7) in the form HHMM.SS where HH is the hour, MM is the minute and SS is the second. The decimal point must appear on the card. Up to five start/stop pairs may be specified for a given report. The count of five may be achieved in one or several commands; however, the times must be in increasing order in order to get

the results wanted. The final quadruple in a command may be abbreviated - if only a start time is given, the stop time is permanently unbounded. If RID is zero, the timeframe(s) bound the entire reduction but the status of individual reports (on or off) is unaffected. Histograms may not be individually delimited with this command, thus the command affects the entire reduction (RID equals zero) or the CPU plot (RID equals 10).

- TIMEFRAME (LOSTDATA)
  Treat the receipt of a GMC lost data trace as the end of one timeframe and the start of another.

- TIMEFRAME Treat the receipt of a reconfiguration trace in which any CPU related data has changed (processor has been released or assigned) as the end of one timeframe and the start of another.

11.6.1.6 Tape Reduction Command Syntax. In addition to those commands given in subsection 11.6.1.3, the following is pertinent to the tape reduction phase.

- TIMEFRAME (0,0,0, STOP TIME)
  By the nature of its construction, the Tape Reduction Module can only produce a nonwindowed set of reports (items M and N of table 11-1). A timeframe set for overall reduction (RID equals zero) will affect only the final stop time for these reports. The start time will always coincide with the start of the GMC collector. For consistency, the histogram of tape drive use (item L of table 11-1) will cover the same period. The stop time must be in the same format as described in previous timeframe commands.

11.6.1.7 Card Input Errors. If the card interpreter cannot understand a command keyword or data item, it will echo the entire card and mark the last correctly interpreted character position with the message "ILLEGAL COMMAND (or DATA) FOLLOWING...." Depending on the state of the interpreter, it may attempt to find the end of the incorrect command in order to pass on to a following command on the same card, or it may reject the remainder of the card; it will report which of the two actions was taken, and will then continue with card interpretation. In no case will an action confirmed by the interpreter be reversed or "undone" by a following error. Due to the manner in which cards are interpreted, the JCL file used to execute the CPUTRP should have the line numbers removed prior to execution. If this is not done, the interpreter will try to process the line numbers on the data cards as valid input requests and generate error messages when unable to do so. Despite the error messages, the CPUTRP will process correctly.

11.6.1.8 <u>Examples of Command Use</u>. A few examples will show the simplicity of the scheme.

o ON (99 1 5 2, 3, 6)
Action: Turns on reports 1, 2, 3, 5 and 6. Report 99 doesn't exist, so that parameter is ignored.

o ON ("1", 002, THREE, 4.0)
Action: Card is ignored since report id's are not one or two digit integers.

o TIMEFR (0 2102.00, 2304.00, 0500.00)
Action: Sets overall data reduction window to start at 2102 hours, stop at 2304 hours, and start again at 0500 hours with a permanently unbounded stop time.

o HISTOG (12, OFF, 42, 1.2, 1+4)
Action: If report ID #12 is a histogram, turns the trailer print flag off. If histogram #12 is of the real continuous type, turns the report on, sets the number of intervals to 42, beginning at 1.2 (Units) with each interval 10,000.00 (Units) wide.

o NEW (*A2345) DEBUG OFF (PL)
Action: Tape number *A2345 is remembered to be the lead off tape for a following run. Both DEBUG and OFF(PL) commands are lost since they appear on the same card. If these commands are desired for the next processing, they should appear on a set of following cards.

o DEBUG DEBUG (TIMSET)
Action: Turns on all debug statements. DEBUG(TIMSET) is a valid command, is correctly interpreted, and is repetitious.

11.7 JCL

The CPU and Tape Reduction Program is controlled by the following JCL:

```
$    SNUMB      ...
$    IDENT      ...
$    USERID     ...$...
```

These are required by the installation.

```
$    SELECT     B29IDPXO/OBJECT/CPU-TAPE
$    LIMITS     99,30K,,20K
```

These two cards load the reduction program object code and begin execution.

The following card,

```
$    TAPEn      01,X1D,,data-tape-number
```

describes the tape (7- or 9- track) generated by the data capture procedure, and

```
$    DATA       05
```

is used to identify the data cards that follow and that specify the input options as described in subsection 11.6.1. When options are not required, no $ DATA card is required.

Figure 11-20 shows a sample deck setup.

11.8 Multireel Processing

If more than a single reel of data has been collected, a series of messages will be outputted to the console informing the operator that a new data reel is required. The following are the messages produced.

a. DISMOUNT REEL #XXXXX THEN MOUNT REEL NUMBER YYYYY ON ZZZZZ

   In this case, XXXXX is the old reel number, YYYYY is the new reel number, and ZZZZZ is the tape drive ID.

   If the operator fails to mount the new tape, the above message will be repeated three times, after which the program will terminate, and all reports produced.

b. IS TAPE XXXXX MOUNTED ON DRIVE ID YYYYY (Y/N)

   In this case, XXXXX is the tape number being requested for mounting and YYYYY is the tape drive ID.

```
$        IDENT        18020251/30/3044
$        MSG2         THIS JOB WILL USE THE FOLLOWING TAPES
$        MSG2         IN THE GIVEN ORDER, ALL RING-OUT
$        MSG2         AJ283, AD281, D0020
$        SELECT       B29IDPXO/OBJECT/CPU-TAPE
$        LIMITS       99,30K,,20K
$        TAPE         01,X1D,,AJ283,,DATA
$        DATA         05
       DATA cards
$        ENDJOB
```

Figure 11-20. Sample Deck Setup

This message occurs when the data reduction program finds the wrong tape has been mounted (by comparing internally generated tape labels). If the operator answers N, the message in (c) below is produced. If the operator answers Y, the data reduction program will terminate and all reports will be produced. In this case, the data reduction program is unable to process the tape. Even though the operator is mounting the correct tape, the internal label on the new tape does not match that being requested by the old tape. The user should check the data collection session to insure that the operator did not respond with an incorrect tape number during multireel change.

After entering the Y or N, the operator will need to hit the EOM key twice in order for the response to be transmitted.

c. WRONG REEL JUST MOUNTED, DISMOUNT AND MOUNT REEL XXXXX ON ZZZZZ

   In this case, XXXXX is the new reel number, and ZZZZZ is the tape drive ID.

d. CAN TAPE XXXXX BE MOUNTED ON DRIVE YYYYY (Y/N)

   In this case, XXXXX is the new desired reel and YYYYY is the tape drive ID.

   If the operator fails to answer this message it will be repeated until he responds with a "Y" for YES or "N" for NO. If he types in "Y", then message (a) will be repeated. If he types in "N", then the program will be terminated and all reports will be produced.

11.9 Tape Error Aborts

During the course of processing it is possible that the operator will be required to abort the data reduction program due to an irrecoverable tape error. If such a condition occurs, the operator should abort the job with a "U" abort. This will allow the data reduction program to enter its wrap-up code processing and produce all reports generated prior to the tape error.

THIS PAGE LEFT INTENTIONALLY BLANK

SECTION 12. TRANSACTION PROCESSING SYSTEM DATA REDUCTION PROGRAM (TPETG)

12.1 Introduction

The Transaction Processing System Data Reduction Program is a FORTRAN program that sequentially processes the data tape written by the General Monitor Collector (GMC). It produces several reports pertaining to response times for user/TPE interactions, in order to help the site analyst fine-tune the TPE parameters for maximum overall efficiency. A list of the information collected is found in table 12-1.

12.2 Transaction Processing System Trace Number

When work on the TPS monitor began, all available system trace numbers (1 to 77 octal) were used either by the dispatcher itself or by other monitors of the GMF. It was decided to use trace 74 for the TPS monitor, as this was least likely to cause a conflict.

12.3 Transaction Processing System Trace Collection

Operator messages to the transaction processing system are routed through the core allocator (POPR). To avoid altering the system software outside of that being monitored, the TPS monitor is turned on or off by the console operator via the TP MESS command, i.e., once the transaction processing system is running, the operator requests "TP MESS". When the console responds "TP MESS?", the message "TRACE ON" is entered to start collecting traces, or "TRACE OFF" to discontinue trace collection.

12.3.1 Sample Decks. Figures 12-1 and 12-2 are sample decks for collecting TPS traces. Figure 12-1 is a compile of the Generalized Monitoring Facility with only the transaction processor data collector. Figure 12-2 illustrates a run of that program. Figure 12-21, at the end of this section, lists the alters that must be incorporated into the WWMCCS transaction processing system in order to collect the GMF traces.

12.4 TPE Tuning Guide Reports

This section and the following section will contain the running instructions for producing the TPE reports. There are two separate programs producing two separate sets of outputs. This section deals with the Tuning Guide reports, and the following section deals with the Tuning Guide formatted dump. Both sections will also contain the input and output formats.

12.4.1 Input. To produce the Transaction Processing Tuning Guide Reports from the TPE System tape, the program B29IDPXO/OBJECT/TPETG must be run. Input parameter cards may be used. They must be inserted immediately after the $DATA I* card in the JCL. If the input parameter cards are omitted, all the data will be reported. The input option consists of START/STOP times for the reports. The first card gives the number of times to follow on the second card. The second card contains a maximum of 5 pairs of START/STOP times. The input is in free format. A description of each follows.

Table 12-1. Transaction Processing System Traces (Part 1 of 2)

SUBTRACE NUMBER TRXD	INFORMATION
1	TPE scans terminals for a connect request
2	TPE connects a new terminal
3	TPE notices a break request from user
4	TPE disconnects a terminal
5	Number of UNDOT table entries increases or decreases by 1. UNDOT is an acronym for UNDelivered OuTput. If a user runs a TPAP that returns information to the terminal, but the terminal is busy or disconnected when the output is ready for transmission, the output is saved until that terminal becomes available (DD36B,p3-15). If memory is unavailable, the undelivered output is written to the journal file (if present)
6	Reason that TPS is unable to continue and is about to abort itself
7	Name of TPAP (Transaction Processing Applications Program) spawned at user request
8	Name of TPAP removed from "quick-access" file in order to spawn another TPAP requested by user
9	Number of blocks of buffer space acquired by TPE, via a MME GEMORE, in order to run a TPAP requested by user
10	Number of blocks of buffer space refused to TPAP, i.e. that TPAP cannot be run at this time due to insufficient core
11	Invalid keyword (request for a specific TPAP) entered
13	Number of blocks of buffer space released after the specified TPAP has finished running
14	Output transmitted
16	One entry of undelivered output (see #5 above) has been retrieved from temporary storage on the journal file
17	INTERCOM message (message sent from one TPAP to another) is reissued, because confirmation that message was received did not arrive at sending TPAP. The need to resend a message could indicate a line problem or a hardware problem
18	TPAP receives INTERCOM line, enabling TPAP-to-TPAP communication to commence
19	Write instruction performed by a TPAP
20	Read instruction performed by a TPAP
21	Snumb of TPAP which terminates abnormally due to operator intervention or because TPS terminates
22	Snumb of TPAP which terminates abnormally due to some error within the TPAP itself

Table 12-1. (Part 2 of 2)

SUBTRACE NUMBER TRXC	INFORMATION
31	Request for TPAP status
32	Table reaching threshold size and the number of times this table has reached threshold size. The TPE threshold and impasse traces are taken when these messages are sent to the operator's console (DD36A, p.6-19). Thresholds are error conditions correctable by TPE. For instance, if an output buffer is full, TPE will direct output to the online printer to prevent an overflow situation. Threshold conditions are counted. When the count reaches certain predetermined levels, the operator is informed and a trace taken. The number of threshold conditions can be reduced by adjusting the buffer sizes specified in the .TPC. macro (DD36, p. 6-10). If TPE encounters an error condition from which it cannot recover, it notifies the operator that it has reached an impasse and terminates itself.
33	Master terminal sign-on accepted
34	IDs of master terminal and second terminal attempting to sign on as a master terminal
35	Master terminal disconnect
40	Compression of TPAP information within TPS's core space attempted. This is done only when the master terminal operator is entering dynamic information for a new TPAP and there is insufficient contiguous storage available
41	Name of new TPAP being dynamically entered into TPS from master terminal
42	Name of TPAP being dynamically removed from TPS from master terminal
43	Name of TPAP being modified by master terminal user
44	Command issued at operator console
45	Command issued at master terminal
52	Initial buffer sizes of major TPS files

```
$         FILEDIT SOURCE,OBJECT,INITIALIZE,NONE
$         DATA    *C,COPY
$         LOWLOAD
$         OPTION  ERCNT/500/
$         GMAP    NDECK,NLSTOU
$         SELECTA B29IDPXO/GMFCOL/GMF/GMF.TOP
$         SELECTA B29IDPXO/GMFCOL/TPE/TP.INIT
$         SELECTA B29IDPXO/GMFCOL/GMF/GMF.MID
$         SELECTA B29IDPXO/GMFCOL/GMF/GMF.MON
$         SELECTA B29IDPXO/GMFCOL/GMF/GMF.BTM
$         GMAP    NDECK,NLSTOU
$         SELECTA B29IDPXO/GMFCOL/TPE/TPE200
$         EXECUTE
$         ENDEDIT
$         ENDCOPY
$         PRMFL  R*,R/W,S,B29IDPXO/GMFCOL/GMF.OBJ
```

Figure 12-1. TPS GMF Compile JCL

```
$          OPTION   ERCNT/500/
$          LOWLOAD
$          EXECUTE  DUMP
$          PRMFL    R*,R,S,B29IDPXO/GMFCOL/GMF.OBJ
$          LIMITS   15,16K
$          PRIVITY
$          TAPE     OT,X2D,,,,RING-IN
$          FILE     DK,X1R,300R
$          DATA     I*
MO M1 M2 M3 M4 M5 M6 M8
```

Figure 12-2. Control Cards for Running Only the TPS GMF

- START - This is a time of day on a 24 hundred hour clock. The format is HH:MM. It can be used to skip the printing of traces created before a certain time. The data for the traces skipped will not be reported at all. To start at the beginning of the tape when using a STOP time, use 00:00 for the START time.

- STOP - This is also a time of day on a 24 hundred hour clock. The format is HH:MM. It can be used to skip the printing of traces created after a certain time. The data for the traces skipped also will be eliminated from all reports. At midnight, the clock will rollover to 00; so this time may be less than the START time.

  An example of the input cards are as follows:

  2 (Card 1)
  22:00,23:30 (Card 2)

After inserting the options desired, the $ TAPE card must be altered to insert the TPE Data Collector tape number before executing the program. A list of the JCL is shown in figure 12-3.

12.4.2 Output. Up to 15 reports can be produced by this program. If no data pertaining to a particular report is found, the report is not produced. All 16 reports listed here are written to report code 08. Example reports are shown in figures 12-4 through 12-18. A list of each report with its description follows.

12.4.2.1 TPE Summary Report. This report includes the total number of reads, writes, invalid keywords, keyword table suppression attempts and TPAPs termed. Also included are the maximum number of UNDOT (undelivered output) entries encountered and the overall time-weighted average number. The maximum number is the largest number of entries in the trace 5 (UNDOT Table Change). The trace 5 obtains the number of entries from the UNDOT table every time a change is made to the table. The average is the sum of the number of entries of each trace 5 times the corresponding time interval divided by the sum of the time intervals.

The minimum, maximum and time-weighted average number of terminals on TPE are reported, where the minimum number is the least number of terminals connected at any one time and the maximum number is the most terminals connected at any one time. These numbers are obtained by adding the terminal connect traces (2) and subtracting the terminal disconnect traces (4). The average is the sum of the number of terminals (trace 2 or 4) times the corresponding time interval divided by the sum of the time intervals.

The minimum, maximum, and average interval in seconds between connect request scans are reported, where the minimum interval is the least amount of time between terminal connect request scans (trace 1) and the maximum interval is the largest amount of time between terminal connect request scans. The average is the sum of the time intervals divided by the total number of scans. Seven different buffer tables (see 12.4.2.5)

```
$         IDENT
$         LOWLOAD
$         SELECT  B29IDPX0/OBJECT/TPETG
$         LOWLOAD
$         EXECUTE DUMP
$         MSG2    1,PLEASE ENTER "U" IF TAPE
$         MSG2    1,ERRORS OCCUR
$         LIMITS  10,45K,-2K,30K
$         FFILE   P*,LGU/(06,08,09,29,42)
$         FFILE   10,NSTDLB,NOSRLS,BUFSIZ/4094,FIXLNG/4094,ERRXIT/KILLFM
$         TAPE    10,X1D,,,,NO-RING
$         DATA    I*
2
22:00,23:30
$         ENDJOB
```

Figure 12-3. JCL for TPE Data Reduction

and the initial buffer sizes in blocks, the total number of thresholds reached by each buffer are produced.

Lastly, the minimum, maximum, average interval in seconds between break requests encountered are also reported. The minimum interval is the least amount of time between noticed break requests (trace 3) and the maximum interval is the largest amount of time between noticed break requests. The average is the sum of the time intervals divided by the total number of noticed break requests. See figure 12-4.

12.4.2.2 NONEW Option Report. This report lists the times in hours, minutes and seconds that an operator console request or master terminal request of NONEW (do not accept new terminals/transactions) or NEW (equivalent of NONEW off) was encountered. See figure 12-5.

12.4.2.3 Profile ID Report. This report lists profile IDs and the time in hours, minutes and seconds that each was either stored or erased. A TPAP profile is information assembled into the Transaction Processing Executive, consisting of the TPAP name, keywords (entry points), I/O buffer sizes, and option flags (DD41, p.4-8). See figure 12-6.

12.4.2.4 Buffer Space Report. This report lists the times in hours, minutes and seconds that blocks were either acquired or released, and the number of blocks acquired or released each time. Each block is 64 words. See figure 12-7.

12.4.2.5 Table Reaching Threshold Size. This report lists the buffer table names and the time in hours, minutes, and seconds that table threshold size was reported to the operator ("TPE THRSHLD ON IP xx LK xx RY xx OT xx TR xx UD xx DB xx"). This message is issued when requested by the operator or the master terminal user, when TPE terminates (unless all counts (xx) are zero), and when any count reaches a predetermined value. The standard values are 8, 64, 512, 4096, 32768, 262144. The message refers to the INPUT (buffer for input buffer assignment, DD36, p.A-3), LINK (message queue entries, DD36, p.A-3), RECOVY (recovery table, DD36, p.A-5), OUTBUF (output buffer queue area, DD36, pp.a-6,7), TRABUF (transmission buffer queue area, DD36, p.A-8), UNDOT (undelivered output catalog, DD36, p.A-9), and dynamic INTERCOM (interslave communications facility, DD41, chapter 5) buffers. See figure 12-8.

12.4.2.6 Master Terminal Report. This report lists the Master terminal IDs, the sign-on times, the disconnect times, other terminal IDs attempting sign-on and those times. All times are in hours, minutes, and seconds. See figure 12-9.

12.4.2.7 Impasse Report. This report lists the time in hours, minutes, and seconds that an impasse occurred in TPS, and an error message was sent to the operator's console. Possible problem areas are LINK, RECOVY, OUTBUF, TRABUF, UNDOT, INPUT, and JC-STS. The first six names specify tables in which the fault may have occurred and are described in paragraph 12.4.2.5 above. JC-STS refers to an unrecoverable error on a

```
     02/28/80     14.766         TRANSACTION PROCESSING TUNING GUIDE REPORTS START TIME 011080 2208.6098  page    1
TAPE(S) 5565                                                                 STOP TIME  011080 2302.5013

                                              TPE SUMMARY REPORT

NO. OF READS     =    52   # KYWD TABLE      # TPAPS                   UNDOT ENTRIES           NO. OF TERMINALS
NO. OF WRITES    =    42   SUPP. ATTEMPTS    TERMED                  MAXIMUM    AVERAGE     MINIMUM  MAXIMUM  AVERAGE
NO. INVALID KYWDS =    1
                                  0              0                     40        33.7          2        5       3.0

  CONNECT REQUESTS SCANS (SECS)     INBUF  = 83 BLKS    INBUF  THRES. TOTAL = 000     BREAK REQ. ENCOUNTERED (SECS)
MINIMUM     MAXIMUM     AVERAGE     RECOVY = 83 BLKS    RECOVY THRES. TOTAL = 004    MINIMUM     MAXIMUM     AVERAGE
INTERVAL    INTERVAL    INTERVAL    OUTBUF = 55 BLKS    OUTBUF THRES. TOTAL = 000    INTERVAL    INTERVAL    INTERVA
                                    TRABUF = 36 BLKS    TRABUF THRES. TOTAL = 000
  0.011      228.86        0.38     UNDOT  = 55 BLKS    UNDOT  THRES. TOTAL = 000      0.001      297.80        3.30
                                    BPOOL  = 55 BLKS    BPOOL  THRES. TOTAL = 000
                                                        LINK   THRES. TOTAL = 000
```

Figure 12-4. TPE Summary Report

11/26/80 14.374 TRANSACTION PROCESSING TUNING GUIDE REPORTS START TIME 111980 158.2392
TAPE(S) 4976 STOP TIME 111980 308.7935

NONEW OPTION REPORT

COMMAND	TIME
NEW	1:59:42
NONEW	2:00:50
NONEW	2:02:37
NONEW	2:27:33
NEW	2:29:45
NEW	2:31:47
NONEW	2:54:45
NONEW	2:55:32
NEW	2:57:51
NEW	2:59:05
NEW	2:59:54
NEW	2:08:42

Figure 12-5. NONEW Option Report

```
   02/28/80  14.766 TRANSACTION PROCESSING TUNING GUIDE REPORTS START TIME 011080 2208.6098
TAPE(S) 5565                                                  STOP TIME  011080 2302.5013

                              PROFILE ID REPORT

                    PROFILE          STORED AT          ERASED AT
                      GM2                                20:43:23
                      GM5             20:44:24
                      GM5             20:45:13
```

Figure 12-6. Profile ID Report

11/26/80 14.374 TRANSACTION PROCESSING TUNING GUIDE REPORTS START TIME 111980 158.2392
TAPE(S) 4976   STOP TIME 111980 308.7935

BUFFER SPACE REPORT

TIME	# OF BLOCKS ACQUIRED	# OF BLOCKS RELEASED
22:18:00	0	8
22:18:01	0	1
22:18:14	0	1
22:18:14	1	0
22:18:22	9	0
22:18:26	0	8
22:18:37	2	0
22:18:40	0	1
22:18:44	1	0
22:18:44	9	0
22:18:44	1	0
22:18:44	0	1
22:18:44	0	1
22:18:48	0	8
22:18:48	1	0
22:18:48	1	0
22:18:48	1	0
22:18:48	0	1
22:18:48	0	1
22:18:48	0	1
22:18:51	9	0
22:18:54	0	8
22:18:55	0	1
22:19:06	0	1
22:19:06	1	0
22:19:06	9	0
22:19:11	0	8
22:19:24	9	0
22:19:27	0	8

Figure 12-7. Buffer Space Report (Part 1 of 2)

BUFFER SPACE REPORT

TIME	# OF BLOCKS ACQUIRED	# OF BLOCKS RELEASED
22:19:36	1	0
22:19:36	9	0
22:19:36	1	0
22:19:37	0	1
22:19:37	0	1
22:19:47	0	8
22:19:47	1	0
22:19:47	1	0
22:19:47	1	0
22:19:47	0	1
22:19:47	0	1
22:19:47	0	1
22:19:56	0	1
22:20:05	9	0
22:20:09	0	8
22:20:14	0	1
22:20:14	1	0
22:20:20	9	0
22:20:23	0	8
22:20:43	2	0

Figure 12-7. (Part 2 of 2)

```
  02/28/80   14.766 TRANSACTION PROCESSING TUNING GUIDE REPORTS START TIME 011080 2208.6098
TAPE(S) 5565                                                     STOP TIME  011080 2302.5013

                                   TABLE REACHING THRESHOLD SIZE

                                    TABLE REACHING        TIME
                                      THRESHOLD

                                       RECOVY           22:42:12
```

Figure 12-8. Table Reaching Threshold Size Report

```
02/28/80   14.766 TRANSACTION PROCESSING TUNING GUIDE REPORTS START TIME 011080 2208.6098
TAPE(S) 5565                                                    STOP TIME  011080 2302.5013
```

MASTER TERMINAL REPORT

MASTER TERM ID	SIGN-ON TIME	DISCONNECT TIME	TERM ID ATTEMPTING	TIME ATTEMPTED
PB	20:34:01	20:50:02	PF	20:40:58
			PF	20:46:09
PB	20:59:57	21:00:27		

Figure 12-9. Master Terminal Report

journal file, and should actually appear as JI-STS for the JOUR-IN file or JO-STS for the JOUR-OUT file (DD36, p.3-5). Suggestions for avoiding IMPASSE faults are described on page 6-19 of the Transaction Processing System Site Manual (DD36). See figure 12-10.

12.4.2.8 Output Transmission Report. This report lists the terminal IDs that received output, the time transmitted in hours, minutes, and seconds and the record pointers indicating the starting address within TPS of the output buffer. See figure 12-11.

12.4.2.9 TPAP ABORT Report. This report lists the TPAP transaction numbers that aborted, the time that it aborted in hours, minutes, and seconds and the reason for aborting. See figure 12-12.

12.4.2.10 UNDOT Entry Report. This report lists the times in hours, minutes, and seconds that an UNDOT (undelivered output) entry was retrieved from the journal file. See figure 12-13.

12.4.2.11 Reissuing Intercom Message Report. This report lists the time in hours, minutes, and seconds and the snumbs of programs reissuing an intercom message between TPE and the TPAPs or between TPAPS. See figure 12-14.

12.4.2.12 Receiving Intercom Message Report. This report lists the time in hours, minutes, and seconds and program names receiving an intercom message. See figure 12-15.

12.4.2.13 TPAP Modify Report. This report lists each TPAP modified, the modify code, and the time modified in hours, minutes, and seconds. The items that can be modified are keywords, priority, flags, and buffers. See figure 12-16.

12.4.2.14 TPAP Status Report. This report lists TPAPs of which the status was requested by the master terminal. The status, the status code and the time in hours, minutes, and seconds the status was requested are also printed. See figure 12-17.

12.4.2.15 TPAP Run Times Report. This report lists all TPAPs that have started and ended within the time limit of this data reduction run. Listed are the start and stop times in hours, minutes, and seconds, the elapsed time in seconds, and the processing time in seconds. A blank EOJ status indicates normal termination. "ABORTED" indicates the TPAP aborted. "TERMED" indicates the TPAP was terminated by an operator. See figure 12-18.

02/28/80 14.766 TRANSACTION PROCESSING TUNING GUIDE REPORTS START TIME 011080 2208.6098
TAPE(S) 5565 STOP TIME 011080 2302.5013

IMPASSE REPORT

REASON FOR "IMPASSE"	TIME
TRABUF	20:37:20
LINK	21:21:23

Figure 12-10. Impasse Report

02/28/80 14.766 TRANSACTION PROCESSING TUNING GUIDE REPORTS START TIME 011080 2208.6098
TAPE(S) 5565 STOP TIME 011080 2302.5013

OUTPUT TRANSMISSION REPORT

RECEIVING TERM ID	TRANSMITTED OUTPUT TIME	RECORD POINTER
PD	22:18:44	053526
PD	22:18:48	052626
PD	22:19:36	054026
PD	22:19:47	053126
PD	22:20:44	054426
PD	22:21:17	053526
PF	22:22:40	050526
PD	22:36:24	053126
PD	22:37:02	053126
PF	22:39:29	050426
PA	22:48:31	050726
PA	22:50:02	047726
PA	22:50:47	051026
PA	22:50:53	050026
PA	22:53:48	051126
PA	22:54:00	050126

Figure 12-11. Output Transmission Report

11/26/80   14.374 TRANSACTION PROCESSING TUNING GUIDE REPORTS START TIME 111980 158.2392
TAPE(S) 4976   STOP TIME 111980 308.7935

TPAP ABORT REPORT

ABORTED TPAP TRANS. NO	TIME	REASON CODE	REASON
22075	22:32:56	12	INTERACT MSG
22075	22:32:56	2	TPAP ABORT

Figure 12-12. TPAP ABORT Report

```
  02/28/80  14.374 TRANSACTION PROCESSING TUNING GUIDE REPORTS START TIME 011080 2208.6098
TAPE(S) 5565                                                  STOP TIME  011080 2302.5013

                             UNDOT ENTRY REPORT

               UNDOT ENTRY RETRIEVED FROM JOURNAL FILE AT 20:50:36
```

Figure 12-13. UNDOT Entry Report

```
 02/28/80  14.374 TRANSACTION PROCESSING TUNING GUIDE REPORTS START TIME 011080 2208.6098
TAPE(S) 5565                                                   STOP TIME  011080 2302.5013

                                    REISSUING INTERCOM MESSAGE REPORT

                                      PROGRAM SNUMB           TIME
                                       REISSUING
                                       INTERCOM

                                        GM500              20:15:12
                                        GM200              20:18:06
```

Figure 12-14. Reissuing Intercom Message Report

02/28/80 14.766 TRANSACTION PROCESSING TUNING GUIDE REPORTS START TIME 011080 2208.6098
TAPE(S) 5565 STOP TIME 011080 2302.5013

RECEIVING INTERCOM MESSAGE REPORT

PROGRAM NAME RECEIVING INTERCOM	TERM ID	TIME OF TRANSFER
GM5	PC	20:17:42

Figure 12-15. Receiving Intercom Message Report

```
   11/26/80  14.374 TRANSACTION PROCESSING TUNING GUIDE REPORTS START TIME 111980 158.2392
TAPE(S) 4976                                                      STOP TIME  111980 308.7935
```

TPAP MODIFY REPORT

TPAP	MODIFIED TIME	MODIFIED ITEM
GMS	20:48:12	FLAGS BUFFERS

Figure 12-16. TPAP Modify Report

02/28/80 14.766 TRANSACTION PROCESSING TUNING GUIDE REPORTS START TIME 011080 2208.6098
TAPE(S) 5565 STOP TIME 011080 2302.5013

TPAP STATUS REPORT

TPAP SNUMB	STATUS CODE	STATUS	TIME STATUS REQUESTED
GM500	1	DATABASE HOLD	22:23:24
GM400	2	PURGE	22:30:23

Figure 12-17. TPAP Status Report

AD-A116 898 COMMAND AND CONTROL TECHNICAL CENTER WASHINGTON DC F/G 17/2
GENERALIZED MONITORING FACILITY. USERS MANUAL.(U)
MAY 82 B WALLACK, G H GERO
UNCLASSIFIED CSM-UM-246-82 NL

6 OF 6
AD A
116898

END
DATE
FILMED
8-82
DTIC

11/26/80 14.374 TRANSACTION PROCESSING TUNING GUIDE REPORTS START TIME 111980 308.7935
TAPE(S) 4976 STOP TIME 111980 322.3402

TPAP RUN TIMES

TPAP NAME	START TIME	STOP TIME	LAPSE	PROC TIME	EOJ STATUS
GM300	2:00:44	2:00:47	2.785	4.1547	
TP200	2:01:29	2:01:31	1.637	2.2912	
TP200	2:02:22	2:02:24	2.498	1.4500	
INT00	2:20:18	2:20:20	2.050	0.	
INT00	2:53:32	2:53:34	1.988	0.	
GM300	2:54:41	2:54:44	2.539	0.	
GM300	2:55:41	2:58:44	182.912	0.	
TP200	3:01:10	3:01:12	1.834	0.	
TP200	3:01:50	3:01:52	1.656	0.	

Figure 12-18. TPAP Run Times Report

12.5 <u>TPE Tuning Guide Formatted Dump</u>

This section will contain the running instructions for producing the TPE Tuning Guide formatted dump. It will also include the input and output formats.

12.5.1 <u>Input</u>. To produce the Transaction Processing Tuning Guide formatted dump from the TGP System tape, the file B29IDPXO/OBJECT/TPEDUMP must be run. Input parameter cards may be used. They must be inserted immediately after the $ DATA I* card in the JCL. If the input parameter cards are omitted, all the data will be dumped. There are five input options available: MAXOUT, TIME, SKIP, OPTION, and LIMIT. The first card has the input option type to follow (e.g. MAXOUT). The second card gives the number of entries to follow on the third card (applies only to the TIME and LIMIT options). The third card contains the input parameter. The input is in free format. A description of each follows.

- o MAXOUT - This option is a limit to the maximum number of traces to be printed. Even though the data will not be printed, it still will be collected for the summary report. The default is 30,000. The second card will contain the new limit.

- o TIME - This is a time window option. The second card is used for this option. It gives the number of times to follow. The third card contains a maximum of 5 pairs of START/STOP times.

    a. START - This is a time of day on a 24 hundred hour clock. The format is HH:MM. It can be used to skip printing traces created before a certain time. The data for the traces skipped will also be collected for the summary report. To start at the beginning of the tape when using a STOP time, use 00:00 for the START time.

    b. STOP - This is a time of day on a 24 hundred hour clock. The format is HH:MM. It can be used to skip printing traces created after a certain time. The data for the traces skipped will also be skipped for the summary report. At midnight, the clock will rollover to 00; so this time may be less than the START time.

- o SKIP - This option is for skipping traces before printing is to begin. The data for these traces will also be collected for the summary report. The default is 0. The second card will contain the number of traces to be skipped.

- o OPTION - This is a print option. If this option is not present, the traces will be printed. If present, only the summary report will be printed. No additional cards are required.

- o LIMIT - This option is a limit to the maximum number of a particular trace type to be printed. The second card is used

for this option. It gives the number of trace types to follow. The third card contains FIRSTX and the trace types (NOPRNT).

a. FIRSTX - This works in conjunction with the NOPRNT. It determines how many to print of each trace type specified in NOPRNT. The default is 0.

b. NOPRNT - This specifies up to 10 trace types for which the printing can be limited. The default is 0.

Examples of the input cards are as follows:

example A
MAXOUT (card 1)
40000 (card 2)

example B
OPTION (card 1)

example C
LIMIT (card 1)
2 (card 2)
100 1,3 (card 3)

In example A the user is setting the maximum number of traces to be printed at 40,000. In example B the user is eliminating printing the traces and only the summary report will be printed. In example C the user is printing only 100 each of trace type 1 and trace type 3.

After choosing the options desired, the $ TAPE card must be altered to insert the TPE Data Collector tape number before executing the program. A list of the JCL is shown in figure 12-19.

12.5.2 Formatted Output. The formatted output contains the TPE trace number in decimal, and the TPE trace number (in octal) in the first half of the first word and the TSS trace number (in octal) in the second half of the first word of the trace itself. Also, the remaining two to six words of the trace itself are printed. Printed next is the title of the TPE trace (a 20 character field). Also printed is the trace time converted to seconds (trace time is microseconds originally) minus the initialization time, and the trace time of day in a 24-hour day. Any BCD representations in the various traces will be displayed in readable format also. This report is written to report code 08. An example formatted dump is shown in figure 12-20.

12.5.3 Summary Report. There is a small summary report written to report code 09 which lists a count of all the traces found and the times (minus the initialization time) in seconds of the first four traces of each trace type, (also shown in figure 12-20).

```
$         IDENT
$         LOWLOAD
$         SELECT  B29IDPX0/OBJECT/TPEDUMP
$         EXECUTE DUMP
$         MSG2    1,PLEASE ENTER "U" IF TAPE
$         MSG2    1,ERRORS OCCUR
$         LIMITS  10,26K,-2K,30K
$         FFILE   P*,LGU/(06,08,09,23,24,25,29,42)
$         FFILE   10,NSTDLB,NOSRLS,BUFSIZ/4094,FIXLNG/4094,ERRXIT/KILLFM
$         TAPE    10,X1D,,,,NO-RING
$         DATA    I*
MAXOUT
40000
$         ENDJOB
```

Figure 12-19. JCL For TPE Formatted Dump

02/27/80 15.847 TRANSACTION PROCESSING TUNING GUIDE REPORTS TAPE 5565

9	000011000074	000000000011	004544536115	BUFFER SPACE ACQUIRD		630.373451	22.3186	
13	000015000074	000010000033	004566316117	BUFFER SPACE RELEASED		635.018318	22.3199	
3	000003000074	202020205252	004650242171	BREAK REQUEST NOTICED		648.103035	22.3235	
9	000011000074	000000000011	004650245025	BUFFER SPACE ACQUIRD		648.104469	22.3235	
13	000015000074	000010000034	004664664256	BUFFER SPACE RELEASD		651.389099	22.3244	
9	000011000074	000000000001	004726525600	BUFFER SPACE ACQUIRD		660.253571	22.3269	
20	000024000074	001515777777	004726535664	READ INSTR PERFORMED		660.257713	22.3269	
9	000011000074	000000000011	004726552631	BUFFER SPACE ACQUIRD		660.264343	22.3269	
9	000011000074	000000000001	004726560461	BUFFER SPACE ACQUIRD		660.264992	22.3269	
14	000016000074	054026004724	004726560461	OUTPUT TRANSMITTED		660.267311	22.3269	
3	000003000074	202020205252	004730167613	BREAK REQUEST NOTICED		660.664200	22.3270	
13	000015000074	000001000034	004730177137	BUFFER SPACE RELEASD		660.667999	22.3270	
13	000015000074	000001000046	004730200363	BUFFER SPACE RELEASD		660.668655	22.3270	
13	000015000074	000010000036	004776117310	BUFFER SPACE RELEASD		670.605003	22.3298	
9	000011000074	000000000001	004776126464	BUFFER SPACE ACQUIRD		670.608688	22.3298	
9	000011000074	000000000001	004776157554	BUFFER SPACE ACQUIRD		670.621552	22.3298	
5	000005000074	000004000041	004776166163	UNDOT ENTRY CHANGES		670.624886	22.3298	
9	000011000074	000000000001	004776204326	BUFFER SPACE ACQUIRD		670.632149	22.3298	
14	000016000074	053126004724	004776210564	OUTPUT TRANSMITTED		670.634354	22.3298	
13	000015000074	000001000035	004776263120	BUFFER SPACE RELEASD		670.656082	22.3298	
13	000015000074	000001000036	004776345545	BUFFER SPACE RELEASD		670.681953	22.3298	
13	000015000074	000001000037	004777706240	BUFFER SPACE RELEASD		671.059105	22.3299	
13	000015000074	000001000001	005041522113	BUFFER SPACE RELEASD		679.912521	22.3324	
5	000005000074	000004000041	005041523333	UNDOT ENTRY CHANGES		679.913177	22.3324	
44	000054000074	000000000001	005054566235	OPERATOR COMMAND		682.814621	22.3332	
3	000003000074	202020205252	005103735644	BREAK REQUEST NOTICED		688.896935	22.3349	
9	000011000074	000000000011	005103740510	BUFFER SPACE ACQUIRD		688.898376	22.3349	
19	000023000074	001515777777	005104261026	WRITE INSTR PERFORMD		689.005081	22.3349	
13	000015000074	000010000036	005123235552	BUFFER SPACE RELEASD		692.927338	22.3360	
7	000007000074	634702000000	005123407021	NAME OF TPAP SPAWNED	TPAP	692.981262	22.3360	TP2
44	000054000074	000000000024	005134361521	OPERATOR COMMAND		695.329620	22.3366	
19	000023000074	001515777777	005134362724	WRITE INSTR PERFORMD		695.330261	22.3366	
20	000024000074	001515777777	005144475430	READ INSTR PERFORMED		697.465622	22.3372	
13	000015000074	000001000035	005144476563	BUFFER SPACE RELEASD		697.466225	22.3372	
9	000011000074	000000000001	005144606033	BUFFER SPACE ACQUIRD		697.502747	22.3372	
5	000005000074	000004000041	005144614422	UNDOT ENTRY CHANGES		697.506065	22.3372	
20	000024000074	001515777777	005144620042	READ INSTR PERFORMED		697.507874	22.3372	
3	000003000074	202020205252	005175507103	BREAK RQUEST NOTICED		704.024132	22.3391	

Figure 12-20. TPE Formatted Dump (Part 1 of 2)

02/27/80 15.847 TRANSACTION PROCESSING TUNING GUIDE REPORTS TAPE 5565

9	000011000074	000000000011	005175511740	BUFFER SPACE ACQUIRD	704.025566	22.3391
13	000015000074	000010000036	005211371213	BUFFER SPACE RELEASD	707.129997	22.3399
3	000003000074	202020205252	005323473716	BREAK RQUEST NOTICED	726.562767	22.3453
9	000011000074	000000000002	005323476600	BUFFER SPACE ACQUIRD	726.564224	22.3453
9	000011000074	000000000001	005327262142	BUFFER SPACE ACQUIRD	727.540833	22.3456
20	000024000074	001515777777	005327273155	READ INSTR PERFORMED	727.545456	22.3456
9	000011000074	000000000011	005327310150	BUFFER SPACE ACQUIRD	727.552101	22.3456
9	000011000074	000000000001	005327311361	BUFFER SPACE ACQUIRD	727.552750	22.3456
14	000016000074	054426004724	005327316000	OUTPUT TRANSMITTED	727.555069	22.3456
3	000003000074	202020295252	005330721553	BREAK RQUEST NOTICED	727.950188	22.3457
13	000015000074	000001000040	005330731040	BUFFER SPACE RELEASD	727.953949	22.3457
13	000015000074	000001000052	005330732253	BUFFER SPACE RELEASD	727.954605	22.3457

TRACE	TOTAL	FIRST FOUR TIMES			
1	8454	2.855432	3.109425	3.363381	3.618357
2	6	49.237865	359.761200	1851.296417	1942.519775
3	807	53.812205	75.882420	97.370882	108.188192
4	3	1460.888000	1916.062317	2735.896271	0.
5	38	66.907244	103.061275	113.680939	143.884554
7	20	6.100223	57.483391	58.140926	90.054187
9	131	53.816041	66.904400	75.883858	90.052096
11	1	228.329462	0.	0.	0.
13	138	6.072093	58.028220	66.780342	89.983652
14	26	96.972860	103.070342	173.941208	189.204172
19	42	8.542897	60.723680	62.633680	93.981119
20	52	66.779792	66.909051	96.961090	143.844147
21	1	1459.802460	0.	0.	0.
22	2	1459.799347	1459.840607	0.	0.
32	7	2015.739761	2015.740311	2015.740854	2015.741394
33	2	869.425728	2414.070435	0.	0.
44	41	8.542246	12.512819	60.723033	62.633066
45	23	928.069572	1028.087509	1046.402167	1084.747772
52	1	2225.681030	0.	0.	0.

9795 TOTAL T74 TRACES

THE PRECEDING FORMATTED DATA PERTAINS TO TAPE(S) 5565
PRODUCED FROM 011080/ 2215.0000
TO 011080/ 2300.0000

Figure 12-20. (Part 2 of 2)

```
COL     COL      COL                             COL
 1       8        16                              32

$       FILEDIT  SOURCE,OBJECT,INITIALIZE,NONE
$       DATA     *C,COPY
$       GMAP     NLSTOU
        LBL      TRXA,NSEQ                                                        TRXA
        SYMDEF   TRXA
TRXA    DEC      0
        END
$       GMAP     NLSTOU
        LBL      TRXB,NSEQ                                                        TRXB
        SYMDEF   TRXB
TRXB    DEC      0
        END
$       GMAP     NLSTOU
        LBL      TRXC,NSEQ                                                        TRXC
        SYMDEF   TRXC
TRXC    DEC      0
        END
$       GMAP     NLSTOU
        LBL      TRXD,NSEQ                                                        TRXD
        SYMDEF   TRXD
TRXD    DEC      0
        END
$       GMAP     NLSTOU
        LBL      TRXZ,NSEQ                                                        TRXZ
        SYMDEF   TRXZ
TRXZ    DEC      0
        END
$       ENDEDIT  END
$       ENDCOPY
$       FILE     R*,Z2S
$       LIMITS   1,,,1K
$       FILE     P*,NULL
$       FILEDIT  SOURCE,OBJECT,UPDATE,NONE
$       LIMITS   ,,,40K
```

Figure 12-21. Transaction Processing System Alter Cards (Part 1 of 15)

```
COL    COL     COL             COL
 1      8       16              32

$      DATA    *C,COPY
$      INCLUDE
$      SYSLD   CATALOG=.MTRAX
$      LOWLOAD
$      OPTION  NOSETU,SYMREF
$      NOLIB
$      MODIFY  SOURCE,OBJECT,TRXA
$      GMAP    NLSTOU                                              TRXA
$      UPDATE  LIST
$      ALTER   10
       PMC     ON
$      ALTER   5652
       TTL     TPTRACE         PERFORMANCE ANALYSIS TRACES OF TPS
       TTLS
       SYMDEF  STTPTR,TREP,MAKTR,EXIT1,JSTOFF,GMFTPO
       SYMREF  UDOTVL,TP3015,TP3016,TP3023,TP3115,.LLINE,TP2055
       SYMREF  TC0950,OUTAVL,MAPTRA,MAPPIO,MAPINP,RECAVL
STTPTR NULL
       INHIB   ON
JSTOFFESTC1    IC              SAVE IC+1
       TRA     *+1             GET OUT OF XED
       SREG    SREGS           SAVE REGISTERS
       EAA     190             PLACE T190 TYPE IN A
       STCA    TRACE1+1,70     STORE SUBTRACE NO.
       LDA     TRACE1+1
       LDQ     =0,DL           ZERO OUT Q
       TRA     MAKTR           GO MAKE TRACE T190
TREP   ESTC1   IC              SAVE IC+1
       TRA     *+1             GET OUT OF XED
       SREG    SREGS           SAVE REGISTERS
       LDA     IC,I            GET PATTERN #, TRACE TYPE
       LDX0    1,DU
       ASX0    IC
       SZN     GMFTPO          CHECK TP TRACE FLAG ON
       TZE     EXIT1           NO
```

Figure 12-21. (Part 2 of 15)

```
COL     COL     COL             COL
 1       8       16              32
        STCA    TRACE1+1,70     STORE SUBTRACE TYPE
        EAX4    0,AU
        TSX1    TABLE-1,4*      TRANSFER TO INDIVIDUAL TRACE
MAKTR   MME     .EMM            ENTER MASTER MODE
        XEC     .CRTRC+2        CHECK TRACE MECHANISM ON/OFF
        TSS     EXIT1           TRACE IS OFF/SEE NOTE BELOW
* NOTE-DURING OPERATION ABOVE SHOULD NEVER BE TAKEN SINCE IF
*TRACE MECHANISM IS OFF, SO WILL BE T74 AND WE WON'T GET
* THIS FAR.
        LDXO    .CRTRC+3        ADDRESS --  XO
        TSX1    1,0*            MAKE TRACE ENTRY
EXIT1   LREG    SREGS,$         RELOAD REG:CNTRL RETURNS HERE AFTER TRACE
        RET     IC,$            RETURN TO TPS
        EJECT
T74.1   NULL
        LDQ     =-1             WD 3 OF TRACE IS EMPTY
        LDA     TRACE1+1
        TRA     0.1
T74.2   NULL
        LDQ     SREGS+5         MAX # TERMS ALLOWED,#TERMS CONNECTED
        LDA     TRACE1+1
        TRA     0,1
T74.5   NULL
        LDQ     UDOTVL          NO. UNDOT ENTRIES AVAILABLE
        LDA     TRACE1+1
        TRA     0,1
T74.7   NULL
        LXL4    SREGS
        STZ     TRACE1+2
        STX4    TRACE1+2        TPAP ID IN 0-17 WD 3
        LDAQ    TRACE1+1
        TRA     0,1
T74.11  NULL
        LDAQ    SREGS+4         STORE INVALID KEYWORD
        STA     TRACE1+4        IN TRACE WDS 5,6 IN ASCII
        STQ     TRACE1+5
```

Figure 12-21. (Part 3 of 15)

```
COL     COL     COL             COL
 1       8       16              32

        LDQ     =-1
        STQ     TRACE1+2        IN 18-35 OF TRACE WD 3
        LXL3    SREGS+1
        LXL4    .ID,3           ID OF USER ENTERING
        STX4    TRACE1+2        INVALID KEYWORD IN 0-17 WD 3
        LDAQ    TRACE1+1
        EAX3    TRACE1+4
        TRA     0,1
T74.14  NULL
        LDQ     TP2055          RECORD POINTER
        ANQ     =0777777007777  AND
        STQ     TRACE1+2        TERMINAL ID
        LDA     TRACE1+1
        TRA     0,1
T74.17  NULL
        LDX4    SREGS+2
        LDQ     .SPWN+1,4       SNUMB
        LDA     TRACE1+1
        TRA     0,1
T74.18  NULL
        LDA     TP3015
        ALS     24
        ARL     6
        STCA    TRACE1+2,70     CURRENT LINE ID
        LDA     TP3016
        STCA    TRACE1+2,07     NEW PROGRAM NAME
        LDAQ    TRACE1+1
        TRA     0,1
T74.19  NULL
        LDX4    TP3023          ADDRESS OF FILE CODE
        LDQ     =-1
        STQ     TRACE1+2
        LDA     0,4
        ALS     18
        STCA    TRACE1+2,70     FC WRITTEN FROM
```

Figure 12-21. (Part 4 of 1

```
COL     COL     COL             COL
 1       8       16              32

        LDAQ    TRACE1+1
        TRA     0,1
T74.20  NULL
        LDQ     =-1
        STQ     TRACE1+2
        LDX4    TP3115          GET ADDRESS OF FC
        LDA     0,4
        ALS     18
        STCA    TRACE1+2,70     FC ISSUING READ
        LDAQ    TRACE1+1
        TRA     0,1
T74.21  NULL
        LDQ     SREGS+4         TPAP NAME
        LDA     TRACE1+1
        TRA     0,1
T74.22  NULL
        LDAQ    SREGS+4
        STA     TRACE1+2        TRANSACTION #
        QLS     6
        LXL3    TRACE1+1        SAVE FORMAT SANS CODE
        STCQ    TRACE1+1,06     CODE FOR REASON BOMBED
        LDAQ    TRACE1+1
        SXL3    TRACE1+1        RESTORE PRISTINE FORMAT
        TRA     0,1
*
************    TRXC TRACES       **************
*
T74.31  NULL
        LDA     SREGS+3         FLAG IN 3L, SNUMB IN 4
        LDQ     SREGS+4
        ANQ     =0777777777700  GET SNUMB
        STQ     TRACE1+2
        ANA     7,DL
        STCA    TRACE1+2,01     FLAG
        LDAQ    TRACE1+1
```

Figure 12-21. (Part 5 of 15)

```
COL     COL     COL             COL
 1       8       16              32

        TRA     0,1
T74.32  NULL
        LXL3    SREGS
        LDA     TC0950+4,3      BUFFER ENCOUNTERING THRESHOLD
        LDQ     TC0950+5,3      # THRESHOLDS REACHED
        STCA    TRACE1+2,07
        STCQ    TRACE1+2,70
        LDAQ    TRACE1+1
        TRA     0,1
T74.33  NULL
        LXL3    SREGS+1
        LDQ     .MIT,3          MASTER TERMINAL TYPE + ID
        LDA     TRACE1+1
        TRA     0,1
T74.34  NULL
        LDX0    SREGS
        SXL0    TRACE1+2        MASTER TERMINAL ID
        LXL0    SREGS+4
        STX0    TRACE1+2        NEW SIGNON ID
        LDAQ    TRACE1+1
        TRA     0,1
************    INITIALIZE TRACE    ***************
*
T74.52  NULL
        LDX0    OUTAVL          OUTBUF
        STX0    TRACE1+2
        LDX0    MAPTRA+1        TRABUF
        SXL0    TRACE1+2
        LDX0    MAPPIO+1        BPOOL
        STX0    TRACE1+4
        LDX0    MAPINP+1        INBUF
        SXL0    TRACE1+4
        LDX0    UDOTVL          UNDOT
        STX0    TRACE1+5
        LDX0    RECAVL          RECOVY
```

Figure 12-21. (Part 6 of 15)

```
COL     COL     COL             COL
 1       8       16              32

        SXLO    TRACE1+5
        LDAQ    TRACE1+1
        EAX3    TRACE1+4        2 EXTRA WORDS IN THIS TRACE
        TRA     0,1
*****************      VARIABLES     **********************
TRACE1OOCT      000004000174    RECORD SIZE,MEDIA CODE,TRACE TYPE
        OCT     74              SUBTRACE,TRACE
        OCT     202020202020    VARYING INFORMATION
        OCT     0               TIME FROM RSCR INSTRUCTION
        OCT     0               USED IN TRACES 11, 52 ONLY
        OCT     0               USED IN TRACES 11, 52 ONLY
SREGS   8BSS    8
IC      BSS     1
TABLE   TRA     T74.1           TABLE OF TRANSFERS TO SUBTRACE ROUTINES
        TRA     T74.2
        TRA     T74.1
        TRA     T74.1
        TRA     T74.5
        TRA     T74.2
        TRA     T74.7
        TRA     T74.1
        TRA     T74.2
        TRA     T74.2
        TRA     T74.11
        TRA     T74.1
        TRA     T74.2
        TRA     T74.14
        NOP                     T74.15
        TRA     T74.1
        TRA     T74.17
        TRA     T74.18
        TRA     T74.19
        TRA     T74.20
        TRA     T74.21
        TRA     T74.22
```

Figure 12-21. (Part 7 of 15)

```
COL     COL     COL                 COL
 1       8       16                  32

        NOP                         T74.23
        NOP                         T74.24
        NOP                         T74.25
        NOP                         T74.26
        NOP                         T74.27
        NOP                         T74.28
        NOP                         T74.29
        NOP                         T74.30
        TRA     T74.31
        TRA     T74.32
        TRA     T74.33
        TRA     T74.34
        TRA     T74.2
        NOP                         T74.36
        NOP                         T74.37
        NOP                         T74.38
        NOP                         T74.39
        TRA     T74.1
        TRA     T74.2
        TRA     T74.2
        TRA     T74.2
        TRA     T74.2
        TRA     T74.2
        NOP                         T74.46
        NOP                         T74.47
        NOP                         T74.48
        NOP                         T74.49
        NOP                         T74.50
        TRA     T74.1
        TRA     T74.52
.ID     EQU     4                   TERM ID IN INPUT BUFFER
.MIT    EQU     6                   WORD 6, MASTER TERMTYPE AND TERM ID
.SPWN   EQU     5                   POSITION OF SPAWN INFO IN .QTPS
CMFTPO  DEC     0
$       MODIFY  SOURCE,OBJECT,TRXB
```

Figure 12-21. (Part 8 of 15)

```
COL     COL     COL             COL
 1       8       16              32

$       GMAP    NLSTOU                                              TRXB
$       UPDATE  LIST
$       ALTER   8
        PMC     ON
$       MODIFY  SOURCE,OBJECT,TRXC
$       GMAP    NLSTOU                                              TRXC
$       UPDATE  LIST
$       ALTER   94
        SYMDEF  TC0950,TC0030,MCOM
$       ALTER   125
        EJECT
        SYMREF  TREP
TRMAC   MACRO
        XED     TREP
        ZERO    #1,60           18/SUBTRACE #,18/MAJOR TRACE #=074
        ENDM    TRMAC
$       ALTER   187
        TRMAC   44              OPERATOR COMMAND
$       ALTER   1095
        TRMAC   31              TRACE SNUMB, FLAG FOR WHICH STATUS REQ
$       ALTER   1448
*
*TRACE  ON/OFF
*
        SYMREF  GMFTPO,JSTOFF
        STQ     STORQ           SAVE QREG
        LDA     TC0693
        CMPA    =6HTRACE        IS THIS A TRACE COMMAND
        TNZ     TCGMF1          NO
        LDA     TC0693+1        YES
        CMPA    =2HON           TRACE ON REQ
        TZE     TCGMF2          YES
        CMPA    =3HOFF
        TNZ     TCGMF1          NOT A TRACE COMMAND AFTER ALL
        SZNC    GMFTPO          TRACE OFF
```

Figure 12-21. (Part 9 of 15)

```
COL     COL     COL             COL
 1       8       16              32

        TZE     2
        XED     JSTOFF          MAKE TRACE TYPE 190
        STZ     GMFTPO          TURN OFF TRACE FLAG
        EAA     GMFTOF          DCW ADDRESS
        TRA     TCGMF3          GO SEND ACKNOWLEDGMENT
TCGMF2  STC2    GMFTPO          TRACE ON, SET FLAG NONZERO
        TRMAC   52              TRACE BUFFER SIZES CALCULATED
        EAA     GMFTON          DCW ADDRESS
TCGMF3  ARL     18              POSITION DCW ADDRESS
        STCA    GMFRIT,07       STORE IN GEINOS SEQUENCE
        MME     GEINOS          SEND ACKNOWLEDGMENT TO CONSOLE
        WTYP
GMFRIT  ZERO    TCO120,**
        ZERO
        MME     GEENDC
GMFTON  IOTD    *+1,5
        OCT     770117171717
        BCI     4,*TPE GMF TRACE STARTED
GMFTOF  IOTD    *+1,5
        OCT     770117171717
        BCI     4,*TPE GMF TRACE STOPPED
STORQ   BSS     1
TCGMF1  LDQ     STORQ
$       ALTER   1748
        TRMAC   32              TRACE OF TABLE REACHING THRESHOLD
$       ALTER   2235
        TRMAC   33              TRACE LID OF MASTER TERMINAL SIGNED ON
$       ALTER   2253
        TRMAC   34              TRACE 2 TERMS WANTING TO BE MASTER
$       ALTER   2335
        LDQ     MBUF+.MIT       TERM TYPE AND TERM ID
        TRMAC   35              TRACE LID OF MASTER TERM DISCONNECT
$       ALTER   2403
        LDQ     MCOM,$
        TRMAC   45              MASTER TERM COMMAND
```

Figure 12-21. (Part 10 of 15)

```
COL     COL     COL             COL
 1       8       16              32

$       ALTER   2546
        LDQ     MBUF+.MIT       TERM TYPE AND TERM ID
        TZE     3,IC
        TRMAC   35              MASTER TERMINAL DISCONNECT AT TP TERM
$       ALTER   4014
        LDQ     MCOM,$
        TRMAC   31              TRACE SNUMB,FLAG FOR WHICH STATUS REQ
$       ALTER   4530
        TRMAC   40              TRACE # KEYWD TABLE COMPRESSIONS ATTEMPTED
$       ALTER   4821
        TRMAC   41              TRACE ID OF PROFILE STORED
$       ALTER   5331
        TRMAC   42              TRACE ID OF PROFILE ERASED
$       ALTER   5444
        SXL2    TRCFLG          TPAP NAME IN BCD
$       ALTER   5743
        EAA     8               KEYWORDS
        ASA     TRCFLG
$       ALTER   5751
        EAA     4               PRIORITY
        ASA     TRCFLG
$       ALTER   5814
        EAA     2               FLAGS
        ASA     TRCFLG
$       ALTER   5817,5817
        TZE     TM169Z          NO BUFFER SIZE CHANGES - DONE - WRITE REP
$       ALTER   5827,5827
        EAA     1               FIXED BUFFERS
        ASA     TRCFLG
        TRA     TM169Z          DONE - WRITE REPORT
$       ALTER   5832
        EAA     1               DYNAMIC BUFFERS
        ORSA    TRCFLG
$       ALTER   5838,5838
        TZE     TM169Z          NO CHANGE IN I
```

Figure 12-21. (Part 11 of 15)

```
COL    COL     COL             COL
 1      8       16              32

$      ALTER   5841,5841
TM169Z LDQ     TRCFLG          TPAP ID IN QL
       STZ     TRCFLG          RESET FLAG INDICATOR
       TRMAC   43              TRACE TPAP MODIFIED
       TRA     TM1475          DONE-WRITE REPORT
TRCFLG DEC     0               FLAGS SHOW WHAT IN TPAP IS MODIFIED
$      MODIFY  SOURCE,OBJECT,TRXD
$      GMAP    NLSTOU                                                   TRXD
$      UPDATE  LIST
$      ALTER   7
       PMC     ON
$      ALTER   73
       EJECT
       SYMREF  TREP
TRMAC  MACRO
       XED     TREP
       ZERO    #1,60           18/SUBTRACE #,18/MAJOR TRACE # =074
       ENDM    TRMAC
$      ALTER   109
       TRMAC   1               TRACE TERMINAL CONNECT SCAN TIME
$      ALTER   432
       LDQ     TERM,$
       TRMAC   2               TRACE # TERMINALS CONNECTED,# ALLOWED
$      ALTER   941
       TRMAC   4               TRACE TIME OF DISCONNECT
$      ALTER   1965
       TRMAC   3               TRACE TIME BREAK REQUEST NOTICED
$      ALTER   2111
       LLR     36
       TRMAC   6               TRACE REASON FOR IMPASSE
$      ALTER   2342
       TSS     *+1             LEAVE MM
       TRMAC   7               TRACE TPAP SPAWNED, TERMINAL ID
       MME     .EMM            RETURN TO MM
$      ALT"    2404
```

Figure 12-21. (Part 12 of 15)

```
COL     COL     COL                             COL
 1       8       16                              32

        TRMAC   8                               TRACE # TPAPS TERMED TO SPAWN ANOTHER
        TRMAC   21
$       ALTER   2781
        SYMDEF  TP0868
$       ALTER   2843
        LDQ     TP0868
        TRMAC   9                               TRACE # WORDS BUFFER SPACE ACQUIRED
$       ALTER   2847
        LDQ     TP0868
        TRMAC   10                              TRACE # WDS BUFFER SPACE UNABLE TO GET
$       ALTER   3083
        TRMAC   11                              TRACE WHO ISSUES WHAT INVALID KEYWORD
$       ALTER   3088
        TRAMC   12                              TRACE TPAP UNAVAILABLE TO USER
$       ALTER   4025
        LDQ     TP1538
        TRMAC   9
$       ALTER   4093
        SYMDEF  TP2055
$       ALTER   4110
        LLR     36
        TRMAC   13                              TRACE # BLOCKS BUFFER SPACE RELEASED
$       ALTER   4985
        TRMAC   5                               TRACE NO. OF UNDOT ENTRIES
$       ALTER   5564
        TRMAC   14                              TRACE OUTPUT TRANSMITTED FOR WHO
$       ALTER   5688
        TRMAC   5                               TRACE # AVAILABLE UNDOT ENTRIES
$       ALTER   6202
        TRMAC   5                               TRACE # AVAILABLE UNDOT ENTRIES
$       ALTER   6584
        TRMAC   16                              TRACE # UNDOT ENTRIES RETRIEVED FROM JOURNAL FILE
$       ALTER   6850
        TSS     *+1                             LEAVE MASTER MODE
        TRMAC   17                              TRACE SNUMB FOR WHICH INTERCOM Z----Z REISSUED
```

Figure 12-21. (Part 13 of 15)

```
COL     COL     COL             COL
 1       8       16              32

        MME     .EMM            RETURN TO MM
$       ALTER   7547
        TRMAC   21              TRACE TPAP TERMED
$       ALTER   8131
        SYMDEF  TP3015,TP3016,TP3023
$       ALTER   8176
        TRMAC   18              TRACE SNUMB RECEIVING CONTROL OF LINE
$       ALTER   8258
        TRMAC   19              TRACE SNUMB ISSUING WRITE
$       ALTER   8300
        SYMDEF  TP3115
$       ALTER   8337
        TRMAC   20              TRACE SNUMB ISSUING READ
$       ALTER   8624
        TRMAC   5               TRACE # AVAILABLE UNDOT ENTRIES
$       ALTER   9275
        TRMAC   21              TRACE TPAP ABORTED
$       ALTER   10704
        TRMAC   22              TRACE TPAP BOMBED, WHY
$       MODIFY  SOURCE,OBJECT,TRXZ
$       GMAP    NLSTOU                                          TRXZ
$       UPDATE  LIST
$       ALTER   8
        PMC     ON
$       INCLUDE
$       ENTRY   TPINIT
$       EXECUTE
$       ENDLD
$       ENDEDIT
$       ENDCOPY
$       TAPE    M*,X1D,,4892,,NO-RING
$       PRMFL   **,R,R,WWMCCS72/W70S-SS
$       FILE    *R,Z2R
$       FILE    R*,X3S,30L
$       SYSEDIT
```

Figure 12-21. (Part 14 of 15)

```
COL     COL     COL             COL
 1       8      16              32

ENDFILE/GMTPE/
$       LIMITS  ,45K
$       FILE    R*,X3R
$       TAPE9   Q*,X2D,,2962,,RING-IN
$       ENDJOB
```

Figure 12-21. (Part 15 of 15)

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 13. EXTENDED USE OF GMC

13.1 Introduction

Throughout this document the Generalized Monitor Collector (GMC) has been described as a trace based performance evaluation tool used to evaluate the performance of certain preselected components of the H6000 computer system. The collectors are all prewritten, as are the data reduction programs and report formats. The user of the GMC has had no clearly defined way of choosing what data is being collected or how to expand the monitoring to other portions of system activity.

In this section, an attempt will be made to describe the procedure that must be followed if a user wants to develop his own monitor. The design of GMC provides the user with a relatively simple method of creating additional monitors. As used in this section, the word monitors does not necessarily mean a performance monitor but rather it is being used in the broader sense of a tool used to check on the operation of a given program or machine component.

13.2 Monitor Structure

Every monitor within the GMC is comprised of an initialization section and a data collection subroutine. The initialization section is used to insure that the correct traces are active, all needed subroutines are present and, finally, to absolutize necessary code in the data collection subroutine. The data collection subroutine is used to process the occurrence of a given H6000 trace, gather whatever data is desired and request the GMC Executive to buffer the collected data to tape, for later processing.

13.2.1 Initialization Section. Prior to coding this section, the user must decide what traces he desires to capture and must select a monitor number. The monitor numbers can range from the letter A through letter F (Monitor numbers 10-15). The H6000 traces are described in the H6000 System Tables Manual (#DD14A). For purposes of this discussion, it is assumed that monitor #C has been selected and it is desired to capture trace OCTAL 27. Figure 13-1 shows the skeleton format required for the initialization section. By following this format, and looking at the initialization sections of the other GMC Monitors, the user should have no problem in writing this portion of the code.

13.2.2 Monitor Subroutine. The monitor subroutine is a master mode program that collects all required data upon execution of the desired trace, and requests the GMC executive to buffer that data to tape. Figure 13-2 provides a skeleton for a monitor subroutine.

In the section where the data is captured, if the user performs the following two statements, every record collected will be time stamped. The data reduction program can then easily convert this time stamp into a wall clock time. The two instructions are:

```
       SYMREF       (Any variables or locations in Monitor routine that
                    need to be absolutized because of register
                    modification)

       LDA    ONOFF+#,$     # = Monitor number (12)
       TZE    USEROF,$      Monitor is off
       LDA    =#,DL         # = decimal equivalent of trace number
                            (23) (OCTAL 27)
       SZN    CVECTR+#,$    # = decimal equivalent of trace number
                            (23) (OCTAL 27)
       TZE    SUBERR,$      Monitor routine missing from R*
       LDAQ   .CRTCT
       ANAQ   USERTC,$     test for required traces being on
       TNZ    TRCERR,$     required trace was off
       AOS    ONOFF+#,$    # = monitor number (12)
       ASX5   XXX,$        absolutize code in the monitor
                           subroutine, if required
          .
          .
          .
          .
          .
       SZN    .CRMBA       Is extended memory on?
       TNZ    USEREN,$     Transfer means yes
       LDA    EXTOFF,$
       ANSA   XXX,$        modify any necessary instructions
              .            because extended memory is off
              .
              .
              .
       TRA    USEREN,$
USEROF STZ    CVECTR+#,$  # = decimal equivalent of trace number (23)
       (repeat for each trace to be captured)
       TRA    USEREN,$
USERTC OCT    (12 Octal digits)   set appropriate bit
       OCT    (12 Octal digits)   to match the trace #'s
                                  being collected
USEREN NULL
```

Figure 13-1. New Initialization Section

```
     LBL     T#C,T#C                 # = OCTAL equivalent of trace
                                     number (27)
     LODM    .G3MAC
     EIGHT
     .ENTRY  XSA2,,,T#C,PRG          # = OCTAL equivalent of trace
                                     number (27)
     SYMDEF  T#,T#C,_ _ _ _ _        # = OCTAL equivalent of trace
                                     number (27)
                                     In addition, any other locations
                                     referenced by the initialization code
     SYMREF  BUFCTL,SVRQ,SVRA        SVRQ contains the Q register from
                                     the trace.  SVRA contains the A
                                     register from the trace.
     INHIB   ON
     TRA     WRAP,$                  wrapup code for when monitor is
                                     terminated
T#   NULL                            # = OCTAL equivalent of trace
T#C  NULL                            number (27)
     (Code to capture any data desired.  Data is written to a user
     defined buffer area.  Code is in Master Mode).
     LDX3    =#,DU                   number of words of data generated
                                     (including time stamp if used)
     STX3    TOPBUF,$
     EAX3    1,3                     count the header word
     EAX2    TOPBUF,5
     TSX1    BUFCTL,5                Tell executive to buffer data
     TRA     GOOD,$                  data written to buffer
     TRA     LOST,$                  internal buffers were full, data is
                                     lost

GOOD data has been buffered.
     Perform any needed housekeeping before returning to system
     TRA     0,0

WRAP monitor is terminating.  Perform any required housekeeping and
     write a final record, if desired
     TRA     0,0

TOPBUFEZERO  0,#                     # = decimal equivalent of trace
     TIME    BSS      1              number (23)
     BUF     BSS      #              # = number of words of data

LOST data was not able to be placed in buffer.
     Perform any needed housekeeping and
     return to system
     TRA 0,0
```

Figure 13-2. Monitor Subroutine

```
RSCR      32
STQ       TIME, $   store the time. This word should be counted in
                    the total number of words of data collected.
```

13.3 User Generated Trace

If a user has the capability of modifying program code, either directly in source, or through patching, and can execute in master mode, he can create his own system traces anywhere within a program. Thus, in effect, he can use the GMC system to monitor the execution of any program of his choice. If the new monitor is being executed in conjunction with the CAM, CPU, GRTS, or MSM monitors, the user must be sure not to use the trace numbers 14, 70, 62, 73 or 76 octal, created by these GMC monitors. Figure 13-3 provides the skeleton code for creating system traces. It should be noted that the time returned from executing the trace code in figure 13-3 is not the same time as obtained from the RSCR instruction described in 13.2.2.

It is also possible to directly transfer into the GMC program. However, this procedure is too complicated to be explained in this document. If the user is interested in using this procedure, he should examine the manner in which the CPU monitor interfaces with the system. Special attention should be paid to files CPU.PAT, CPU.REMO, and CPUDOIT. When using this method the user will need to alter his monitor routine with the addition of three instructions. These instructions check whether the user generated trace, or a system trace is being processed. System traces will be ignored. In figure 13-2, following label T#C the following three instructions should be added:

```
LXL2   SVRA,5      get the trace number
CMPX2  =05757XX    where XX = octal trace number
TNZ    0,0         system trace ignore
```

13.4 Data Reduction

In order to analyze the tape generated by the new monitor, a data reduction program must be coded. This step will prove to be the most difficult and time consuming step to execute. In order to proceed with the coding of a data reduction program the user should examine the source code of the already existing GMC monitors. Much of the code needed to process the GMC tape is already written and can be used with minimum modification by the user. For purposes of this document, the CM data reduction program will be used as an example. The remaining description assumes that the user has a source listing of CM available to him.

13.4.1 Subroutine INITZ. This subroutine performs many functions within the program but the areas of interest at present begin at the first lines of executable code. At this point in the code the initial data record on the tape is read, the initial start time of data collection is determined and the system configuration is determined. This initial record was written to tape by the GMC executive and must be processed before the user can begin to reduce the records generated by his monitor. Much of

```
          XED     .CRTRC
          TRA     DONE,$                  code to be executed when trace
                                          is completed or if trace is off
          Code to set up A&Q
               registers

          ORA     =05757XX,DL             where XX is the octal trace number
                                          desired to be used.  The 5757 insures
                                          that the GMC will be able to distinguish
                                          this user generated trace from a system
                                          trace of the same number.
          TRA     -1,0 (Time of Day in Q register)
              or
          TRA     1,0 (A & Q registers not changed)
     DONE NULL        return code or trace off code
```

Figure 13-3. Creation of User Trace

the data in this record can be ignored by the user, if he is not interested in the system configuration. However, execution of this code exactly as written will insure proper execution. The meaning of each word within this initalization record can be found in section 5 of this document. All code down to the beginning of the 1000 do loop should be executed. The key points that should be noted are as follows:

- o DATPTR - This word will now point to the header word of the first monitor trace on the tape.
- o INDATA - Array which contains a complete GMC record, i.e., 4090 words.
- o HOUR - Starting hour of the data collection
- o MINUTE - Starting minute of data collection
- o PMHOUR - Current hour
- o PMINUT - Current minute
- o PMSECD - Current second
- o PTIME - Current RSCR time stamp
- o ORGTIM and STRTIM - Initial RSCR time stamp
- o OLDT,BEGINT - Variables needed for later time calculations

upon leaving subroutine INITZ the user can begin to process trace data. The variable DATPTR points to the header record of a monitor trace with bits 30-35 of this word indicating the trace number of the data following.

13.4.2 Subroutine NXTRECRD. After having processed a monitor trace or determining that this monitor trace is of no interest, a call to subroutine NXTRECRD will advance DATPTR to the next monitor record.

13.4.3 Subroutine RLOVER. If the user is interested in maintaining a wall clock time for each monitor trace executed, the following code should be executed:

PTIME = AND (INDATA(DATPTR+X),MAKPLS) Where X is the offset for the RSCR time word in the trace.

STARTM = ORGTIM

SBEG = BEGINT

CALL RLOVER

TIMES = TIMES/100000 + SBEG

At this point, TIMES will contain the total run time accumulated thus far in 1/10 seconds. MAKPLS is a variable that is defined within the CM program.

13.4.4 Subroutine TIMEDAY. In order to convert the variable TIMES into a wall clock time, the following code should be executed:

```
CALL TIMEDY2
PMHOUR = PHOUR
PMINUT = FMINUT
PMSECD = FSECOND
```

PMHOUR, PMINUT and PMSECD will now contain the current wall clock time.

13.4.5 Subroutine MAIN. The GMC executive will create several additional trace records that must be checked for by the user and must be processed correctly. The first is a lost data record which indicates that one or more buffer records were lost and not written to tape. Another record is a monitor termination record and indicates that data collection has been completed. All these record types are processed in the MAIN subroutine and the user should reference this code for proper handling of these record types.

13.4.6 Other Routines. The CM data reduction program also contains routines for creating histograms and plots. However, for purposes of this document, these routines are too complicated to explain. This chapter should allow a user to be able to write his own monitor and begin the process of writing a data reduction program. The user should note that two subroutines required for all data reduction programs are ALIGN and EVENUP.

13.5 Utility Tape Dump

If the user is interested in quickly being able to see the data that was collected he can run a standard Utility Tape Dump. The following JCL should be used:

```
$    UTILITY
$    LIMITS         10,40K,,30K
$    FFILE          01,NSTDLB,NOSRLS,BUFSIZ/4094,FIXLNG/4094
$    FUTIL          01,,RWD/01/,DUMP/XR/
                        where X = number of records to be dumped
$    TAPE           01,X1D,,Tape#
$    ENDJOB
```

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 14. CONDUCTING A SITE COMPUTER PERFORMANCE EVALUATION USING THE GMC

14.1 Introduction

A general plan for using the GMC System and document when conducting a performance evaluation of a Honeywell 6000 computer system is presented in this section. Detailed analysis procedures that guide the analyst in applying specific techniques to analyze system performance are introduced. The primary purpose is to aid the analyst in his use of the GMC reports. This section will indicate which reports the analyst should reference, what data he should extract from those reports, and some guidance as to what the reports are indicating. In some cases, possible corrective ("tuning") recommendations will be made, but tuning guidance is not the primary purpose behind this section. If a tuning study should be made, the user must rely on his own personnel skills and the tools of GMF to perform such a study.

14.2 General Definitions

14.2.1 Computer Performance Evaluation (CPE). Computer performance evaluation is a generic term applied to many techniques for determining the performance characteristics of both a computer system and its associated site processing activities. The performance characterisitics may be compared to many criteria, including: (1) standards of economic operation, (2) technical norms, or (3) measures of service provided.

14.2.2 Computer System Performance Variables. The performance of a computer system is influenced by nearly every facet of the data processing function. The following examples define the scope of the computer performance function.

14.2.2.1 System Design. Computer application system design and development can be the starting point of performance degradation. Errors in original design with respect to I/O media selection, file structures, frequency of run, etc., may result in less than optimal performance for as long as an application is in existance.

14.2.2.2 Programming. A computer programmer's proficiency and the availability of program optimization tools, for example, will influence program design and coding, and affect system performance.

14.2.2.3 Hardware Configuration. Specific components of a computer system may be mismatched to the system as a whole, causing major subsystems (or the entire configuration) to operate at a reduced performance level. Even if the performance capabilities of the individual subsystems are reasonably well-matched, the system may be poorly configured for the site's workload, resulting in poor performance.

14.2.2.4 System Software. System software is considered to be those programs supplied by the mainframe vendor. This software may be inappropriately parameterized to fit the site workload, or may be a source of high overhead or bottlenecks to efficient workload processing.

14.2.2.5 Operations. Operations consists of functions such as the scheduling of the workload, providing job assembly (and library) services, and operating the system through the console. All of these functions are vital to the proper operation of the system. Mistakes, insufficient training, poor documentation, and a variety of other factors may contribute to operational problems which substantially decrease system performance.

14.2.2.6 Communications Hardware and Software. A communications network, its interface to a central system, and the software used to control the on-line applications, may have a significant impact on the system's overall performance.

14.2.2.7 Computer System Performance Tuning. The process of analyzing and appropriately adjusting computer system performance variables is known as computer system performance tuning. After becoming proficient in the use of GMF, the user should be able to conduct his own tuning study.

14.2.2.8 Turnaround Time. This is the total elapsed time taken by a job (or set of jobs) submitted to a WWMCCS site for batch processing. Total batch turnaround time is comprised of computer system processing and physical input and output handling in the machine room, both before and after system processing. A job's total turnaround time therefore includes all processing and waiting points through which the job must pass from submission until return to a user. The GMC measures only a batch job's computer processing turnaround time. The other measure of total turnaround time (input/output handling) are important and can be a bottleneck to total turnaround time.

14.2.2.9 CPE User Objectives. The definitions associated with any or all of the above data processing functions can be considered variables that affect computer system performance. The GMC reports should be used to determine which of the above functions need further investigation.

14.3 Solutions to Performance Problems

Particular resource bottlenecks may be confirmed as elongating turnaround or response time. Several solutions can usually be applied to remove a particular bottleneck. In general, four kinds of solutions exist to remove identified bottlenecks.

14.3.1 Scheduling Solutions. These solutions change the way that either batch or TSS workloads are scheduled for processing. They shift particular workloads to more evenly distribute system resources across the workload.

14.3.2 Parameter Solutions. These changes involve adjustments to system or subsystem functions. Examples include: (1) changes to the

parameters of the GCOS Dispatcher or (2) a change in the placement of GCOS libraries. A solution may also include specific changes to GCOS code, made through authorized software patch procedures.

14.3.3 Programming Solutions. These changes can involve modification of one or more processing jobs running in the system. Recommendations may be made to speed application of jobs by changing particular file locations discovered as delaying the job.

14.3.4 Sizing Solutions. These types of system changes involve an increase, decrease, or realignment in the system's hardware configuration.

14.4 Structure of the Analysis Process

The analysis process in figure 14-1 is a flow chart that should be referenced during a performance study. The analysis process is comprised of two phases: (1) a Problem Definition Phase and (2) a Problem Analysis Phase. The activities of the Problem Definition Phase are directed toward determining whether a batch turnaround time or TSS response time problem actually exists. The activities of the Problem Analysis Phase are directed toward revealing causes of the identified turnaround time or response time problem.

14.4.1 Starting The Process. The evaluation process may begin in one of three ways: (1) by direct request, (2) by an internal review of site-selected service elongation metrics, (3) by user requests.

14.4.1.1 Direct Request. The request may by initiated by WWMCCS management, directing a facility to perform an analysis and tuning effort. Many reasons could cause management to request a CPE study. Examples include: (1) desire to extend the life of a system, (2) pressure applied from users through higher authority, (3) awareness of the potential for performance gain after an evaluation, and (4) a desire for management to evaluate cost reduction programs.

14.4.1.2 Internal Review. The decision to initiate a study may result from the output of a performance exception reporting system or from the desire to conduct a periodic review of site operations.

14.4.1.3 User Requests. Users of site services may request an evaluation. Complaints of unacceptable batch turnaround time or TSS response time can initiate a search for their causes. Unfavorable comparisons with service rates provided at other installations can point out the need for a study to determine if service can be improved.

14.4.2 Problem Definition Phase. The Problem Definition Phase (see figure 14-1, part 1) is comprised of four activities: (1) define and verify the problem, (2) gain understanding of facility environment, (3) understand installation service objectives and priorities, and (4) specify current evaluation objectives. Some of these activities are initiated as evaluation begins. Others are maintained as on-going activities. The activities of the Problem Definition Phase are introduced below.

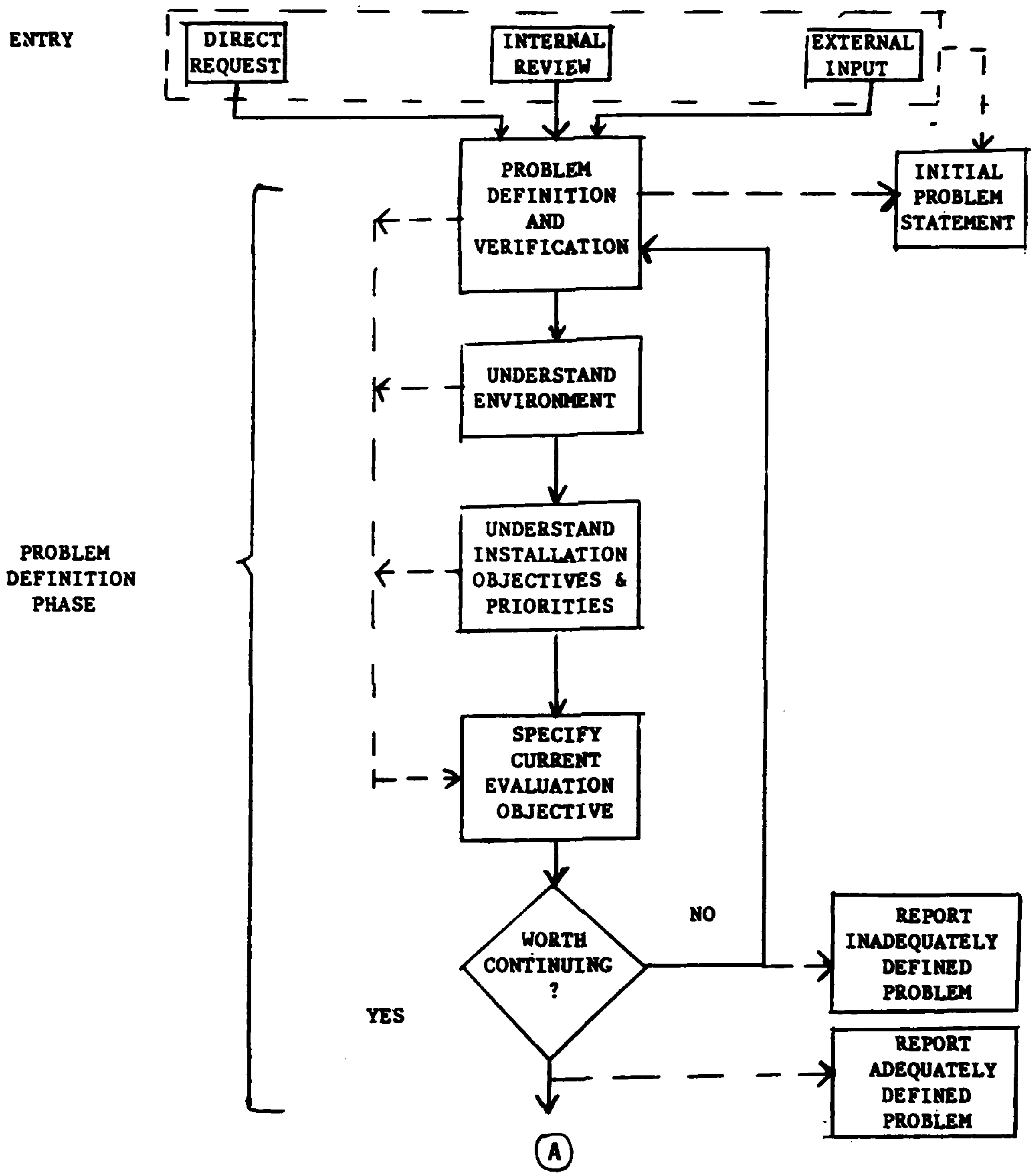


Figure 14-1. Flowchart Of Evaluation/Tuning Process (Part 1 of 2)

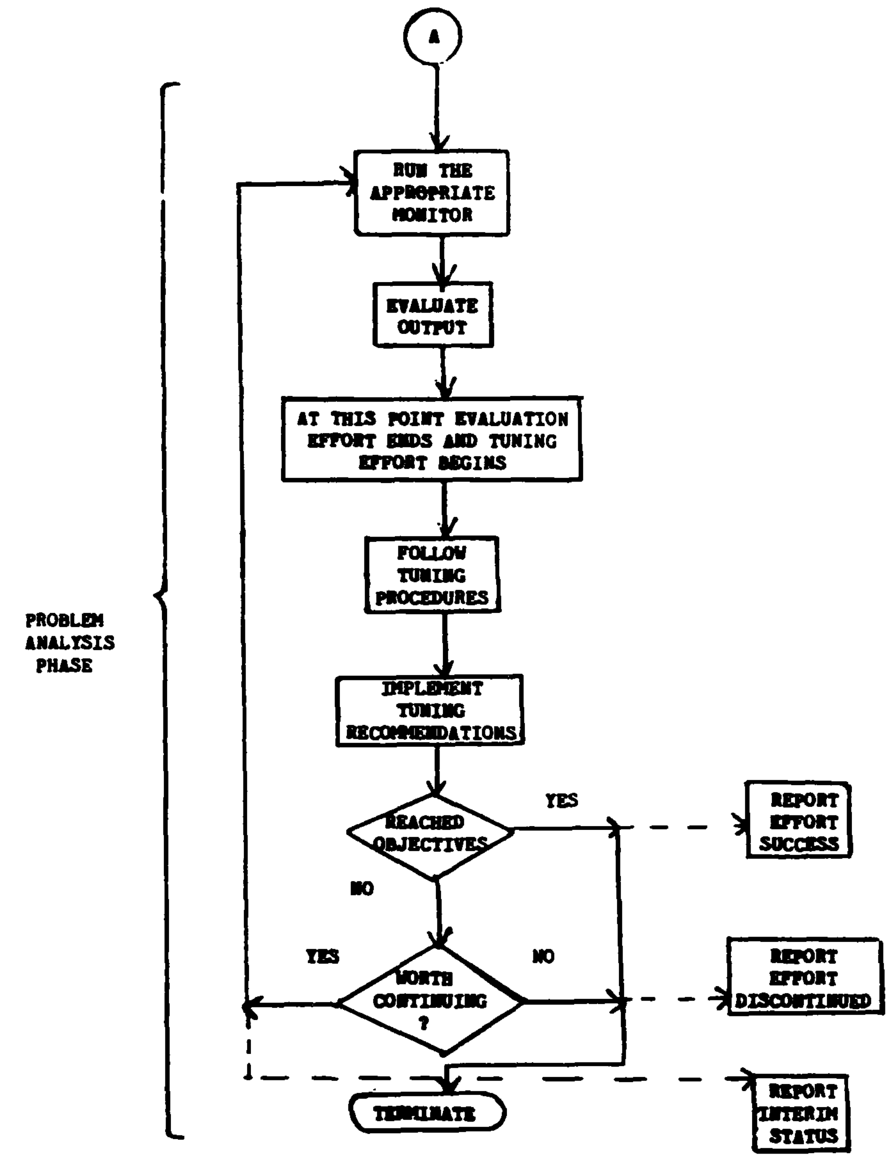


Figure 14-1. (Part 2 of 2)

14.4.2.1 Define and Verify the Problem. For whatever reason the evaluation was initiated, a starting point or premise must be established. The problem must be described as well as it can at this point, even if at a very general level. "Batch turnaround time is poor" or "TSS response time must be improved" are valid statements of problems at this time. Site management must then verify that this is the problem they wish to pursue. The facility staff and users should verify that, in fact, this problem does exist and that they view it as a problem of importance. Note that a specific evaluation objective is not yet defined; only the basic problem statement is verified.

14.4.2.2 Gain Understanding of Facility Environment. This second step helps the CPE analyst relate the system environment to the problem statement. This activity may be time-consuming if the analyst has little personal experience with the facility and the system. Information collected during this activity will help determine the reason for the problem's importance; it may explain a reason for the problem's existence and help rank one problem against another. The activity forces an analyst to view the entire facility; this is important since many performance problems are caused by combinations of factors. The activity assists the analyst in understanding how to narrow, refine, modify, and improve the problem's definition in order to attempt a valid solution. Each area described in the following paragraphs should be examined. It may help the analyst to examine them in the order they are given below.

14.4.2.2.1 Hardware Configuration. The exact system configuration should be determined and a diagram of the overall structure of the system should be created. Collection of reliability statistics on major configuration components and a history of hardware changes to the configuration should be done.

14.4.2.2.2 Software Configuration and Development Practices. The exact operating system configuration should be determined. Any local changes made to the system and any specialized major subsystems that are running should be documented. Document software monitors and other CPE measurement techniques used. Determine program optimization techniques used and note standards imposed on operations and programming staffs.

14.4.2.2.3 Existing CPE Practices. Responsibility for computer performance evaluation at the site must be determined. Identify sources of CPE data that are employed and determine how the data are used to evaluate system performance. Determine if personnel in all site functional areas (e.g., programming and operations) can relate to the performance data. Research how previous CPE studies conducted at the site in the past have been documented.

14.4.2.2.4 Site Workload Characteristics. The existing workload uses of system resources should be scribed. Identify patterns of resource use by selected jobs. Obvious bottlenecks to the handling of jobs within the installation should be determined. The resource monitor, the RMC portion of GMF, should prove very useful during this phase.

14.4.2.2.5 System Users. The workload analysis should be expanded by investigating the practices of the major users in the installation. Determine how special priorities are assigned to these users and whether the users can directly control system resources. Note chargeback schemes used (if any) to level the workload across the operating day and night. Evaluate the levels of user satisfaction (or dissatisfaction) exhibited.

14.4.2.2.6 Operations Practices. The operating shift schedule for the site should be examined. Analyze pre-scheduled and nonproduction time and unscheduled nonproduction time. Evaluate training provided for operators and systems programmers. Study site library maintenance procedures. Examine the production control points established by operations. Observe how formalized logs are maintained to track work as it passes through the installation.

14.4.2.2.7 Batch Job Scheduling. Observe how batch work is accepted for processing at the site. Study the techniques used to schedule the batch workload that are either automated or are manually implemented.

14.4.2.2.8 Site and Computer Facility Organization. Study the organization structure and reporting authority at the site. This includes the organization of the site itself. Determine the extent to which system sizing activities are organizationally separated from operations and applications systems development.

14.4.2.3 Understand Installation Service Objectives and Priorities. This third step determines site processing objectives and priorities to be applied to decisions made during both the Problem Definition and Problem Analysis Phases.

14.4.2.3.1 Installation Service Objectives. To be effective, a CPE effort must consider the hardware, software, personnel, and service objectives of the computer installation being analyzed. Although the first three areas are readily identifiable, the site's service objectives are often misunderstood. An installation's objectives can emphasize production or availability, or a mixture of both. A mixture is generally dominated by either a production or availability objective. A production objective attempts to take full advantage of the capabilities of the system in terms of throughput. With a customer-oriented availability objective, however, the interests of the users take priority over the most efficient use of system resources. In either case, the computer installation's management objective is return on investment. For the production objective, the most important investment

is the computer; for the availability objective, the most important investment is the people or system using the computer. The difference between these two objectives is reflected in how the performance parameters are evaluated.

14.4.2.3.1.1 Production Objective. Traditional data processing is production-oriented. The computer installation is viewed as a large investment for capacity to do routine work. Much of that capacity depends on a high degree of simultaneous use of many system components. Management's production objective is to use as many of the components as much of the time as possible by scheduling compatible jobs. Under these conditions, low batch turnaround and TSS response times are secondary to high machine utilization. Management's success is generally defined in terms of a relatively high number of jobs contending for computer resources (a high multiprogramming level), high central processor unit (CPU) activity, nearly full memory utilization, and highly active channels. Schedule-driven processing uses internal and external priority allocations to sustain efficiency. Programs must be written to share available resources. This can be done with program segmentation techniques, use of a minimum number of devices, the indirect use of input/output through spooling, and adherence to rigid standards -- all at the expense of the individual job. Data must be so distributed that device activity is economically justified with the attainment of a low system wait, low unit cost, and high simultaneity.

14.4.2.3.1.2 Availability Objective. Service-oriented systems are more concerned with return on investment for users (managers, scientists, or programmers) than with the computer itself. Low TSS response and batch turnaround times are critical. Their increase delays user operations on such applications as on-line command and control systems, real-time update systems, scientific support services, and program development systems. Demand-driven processing varies in activity levels, both by users and type of work. Minimum emphasis is placed on scheduing. The system must therefore have available capacity ready to respond to demand. Such a system must have utilization rates well below the 100% limit in order to accommodate the variations in demand. Success is measured in terms of user satisfaction and little emphasis is placed on reporting high utilization figures.

14.4.2.3.1.3 Mixed Objectives. Usually computer installations encounter (1) demands for highly responsive services and (2) pressure from management for high production rates. The two objectives are not mutually exclusive. Predominance of either objective can be identified within operational time periods, and management must evaluate whether the satisfaction of one objective might deleteriously affect the satisfaction of another.

Computer performance evaluation can serve the management of either type of computer installation and can also serve mixtures that might have different objectives, depending on the time of day or day of the week. However, it is important that managers, auditors, and executives recognize the implications of the different objectives when they compare the performance of one installation to another.

14.4.2.3.2 Installation Priorities. The installation's priorities derive from the predominance of either the production objective or the availability objective at a particular site. They also, by implication, determine the sequence in which system tuning solutions are applied.

14.4.2.3.2.1 Service Priorities. A site may feel that low TSS response time is more desirable than low batch turnaround time for a certain period of the operating day. The analysis procedures presented in this section are not generally directed toward determining which of the two is "more important". However, the sequence of examining either of the two service areas may be affected by this priority.

14.4.2.3.2.2 Evaluation/Tuning Solution Priorities. Tuning solutions are presented to correct system bottleneck conditions. In nearly all cases, more than one solution is specified to correct a problem. The solutions are generally proposed in a sequence that recommends the more quickly (or easily) applied solution be implemented before others. Installation requirements may change this sequence.

14.4.2.4 Specify Current Evaluation. This fourth step is used to determine whether the originally specified problem can actually be investigated with currently-available procedures.

14.4.2.4.1 Objective. An objective is a stated (i.e., documented) goal of an analysis. An objective must be stated in specific and quantified terms. The objective statement is used to determine when a particular analysis has been completed. Examples of well-stated objectives are: (1) "reduce mean response time for (stated) non-trivial TSS commands to five seconds" and (2) "reduce the mean batch turnaround time for (stated) jobs to 1.5 hours." A well-stated objective includes: (1) definition of the workload catagory, (2) a description of the process to be investigated, and (3) a service metric value. Examples of badly-stated objectives are "reduce TSS response time" and "improve turnaround time." Note the missing components of these objectives.

14.4.2.4.2 Objective Decision. Determine whether the objective as documented is realistic, attainable, and a cost effective target.

14.4.2.4.2.1 Attainable Objectives. Objectives must be attainable. It might be possible to reduce a program's elapsed time to certain limits, but not to a desired limit, simply because of the quantity of I/O and computation that occurs within the program. If this is the case, re-evaluate the objective.

14.4.2.4.2.2 Realistic Objectives. It might be possible to reduce a program's elapsed time to the desired amount. However, particular site constraints may prevent its being a realistic goal. These constraints

might have their source outside of the tuning effort, but directly affect the internal performance of the program. These might include, for example, the requirement to give certain other jobs higher priority. If this is the case, re-evaluate the objective.

14.4.2.4.2.3 Cost-Effective Objectives. The additional effort, cost, and time required to achieve an attainable and realistic objective might not be worth it. A particular increment of performance improvement might simply not be cost effective. Determine the amount of improvement likely with additional effort. Decide whether the effort might be better off abandoned.

14.4.2.4.3 Determine if Worth Continuing. The final part of step four is to determine whether the process itself is worth continuing. There may be potential performance problems of greater magnitude or immediate importance that may have been uncovered during the Problem Definition Phase. Document the decision and the objective and obtain management approval of them.

14.4.2.4.4 Begin Problem Analysis. Having obtained concurrence from management, begin the second half of the performance evaluation process (see figure 14-1, part 2): the Problem Analysis Phase. Activities of this phase involve the execution of the various GMC monitors and the analysis of their output.

14.4.3 Problem Analysis Phase. The Problem Analysis Phase (see figure 14-1, part 2) is comprised of five activities briefly described below:

14.4.3.1 Run Appropriate Analysis Tool. Analysis requires collection of data to start an investigation. The various GMC monitors have been developed for this purpose.

14.4.3.2 Evaluate System Output. The output from the various GMC monitors must be analyzed.

14.4.3.3 Follow Tuning Procedures. The user must develop his own skill in developing provide specific procedures to test hypotheses by examining the reports produced by the GMC monitors. Specific system tuning steps can result from the tests.

14.4.3.4 Evaluate Need to Continue the Tuning. This decision is made after the relevant recommendations have been implemented. If the current objective (specified in the last activity of the Problem Definition Phase) has not been met, the user analysis can define areas for further investigation.

14.5 Composition of a Performance Evaluation Team

While this section has been developed to aid WWMCCS ADP Managers in the application of various computer performance evaluation tools and techniques, the actual team conducting this analysis must have a reasonable education and experience level on the H6000. The team should be comprised of at least one individual familiar with system software and its operation; one individual generally familiar with system hardware (at least in terms of functionality); one individual familiar with the procedures for executing jobs on the H6000 and at least one individual (probably a manager) who is familiar with the objectives and priorities of the installation. It certainly is possible that one individual may be able to handle several of the above functions.

14.6 System Evaluation

14.6.1 Introduction. A total system evaluation should be performed at least once a year. It may have to be performed more often, depending upon the results of daily resource statistics. A steady increase in resource utilization would possible imply the need for an evaluation. The Resource Monitor (RMON) of GMF should be used to track daily resource utilization.

The data collected for the detailed system evaluation must be representative (i.e., typical) of the data that would be collected on a "normal" day. This requires the collection of data over several time periods. The suggested schedule for collecting data for a total system analysis is to run the GMC monitors intermittently for two weeks. The monitors should be run as two separate groups, on alternate days. Group one would consist of the Memory Utilization Monitor (MUM) (possibly the Idle Monitor (IDLEM)), CPU Monitor (CPUM), Communications Analysis Monitor (CAM), and the GRTS Monitor (GRTM). Group two would consist of the Mass Storage Monitor (MSM), Channel Monitor (CM), and possibly the Idle Monitor (IDLEM). This sequence provides a good representative sample of the system workoad. To limit the amount of data collected, it is advisable to run Group Two only during prime time, heavy usage (4-6 hours per day). It may also be desirable to run the combined set of monitors at least once per week during the two-week monitoring session. This allows the analyst to get a complete, unified picture of the entire performance of the system. It must be realized that a large number of tapes can be generated under such a monitor configuration. Therefore, data collection should be limited to no more than four hours (during heavy prime time usage).

14.6.2 Selecting a Representative Value From GMC Histogram Reports. Some test procedures require an analyst to pick a "Representative Value" to describe a frequency distribution. The following paragraph gives guidelines for choosing Representative Values based on the type of distribution observed.

Figure 14-2 shows a hypothetical "Total Elapsed Time an Activity Was in Memory" report. Variations of this report will be used to illustrate types of distributions. This chapter will reference only the pictorial part of the report. All other parts of the histogram report are described in Chapter 6 of this document.

14.6.2.1 Symmetric Distribution Closely Clustered Around a Single Point. The "Representative Value" for the distribution shown in Figure 14-2 is easy to select. The values are clustered around the "Average": 17.6 tenths of a

```
DISTRIBUTION COLLECTED ON SYSTEM NMCC at 14:41:24 on 81-05-15

The Total Elapsed Time An Activity Was In Memory

            Percent of Occurance            Report 21

Tenths   00   05   10   15   20   25   30   35   40   45   50
Second    /    /    /    /    /    /    /    /    /    /    /
10-10     I
11-11     I
12-12     IX
13-13     IXX
14-14     IXXXX
15-15     IXXXXXXXXXX
16-16     IXXXXXXXXXXXXXXX
17-17     IXXXXXXXXXXXXXXXXXX
18-18     IXXXXXXXXXXXXXXXXXX
19-19     IXXXXXXXXXXXXXXX
20-20     IXXXXXXXXX
21-21     IXXXXX
22-22     IXX
23-23     IX
24-24     I

9276 Entries Total   Average 17.62   Variance 4.85   Standard Deviation 2.20
```

Figure 14-2. Sample Symmetric Distribution

second, or 1.76 seconds. The shape of the distribution is symmetric -- about the same number of activities had values over 1.76 seconds as under 1.76 seconds, and the standard deviation is small when compared to the average. The absence of a second line under the "Entries Total" line indicates that no activities stayed in memory longer than 2.4 seconds. When a distribution resembles this example, use the "Average" printed at the bottom as the Representative Value.

14.6.2.2 Skewed Distribution. Figure 14-3 shows another distribution. This distribution is "skewed" (i.e., not symmetric), because most of the activities spent around 0.1 to 0.7 seconds in memory, while some spent as much as four or five seconds. Care should be taken when selecting a "Representative Value" from this distribution. If the analyst wants to emphasize the "typical" activity, which stayed in memory 0.3 seconds or less, he could select the "median" (the value which evenly divides the activities in the distribution -- half spent less time in memory, and half spent greater time in memory). In figure 14-3, the median is about 0.29 seconds. The median can be estimated from these reports by descending down the "Cumulative" column (not displayed in the figure) until the value first exceeds 50. The median falls within the time range of this row.

14.6.2.3 Distribution With Outliers. There are some instances when the distribution will also have some values that were too big to fit in the histogram. This condition will be indicated by an additional output line at the bottom of the report. This line will indicate the number of occurrences that were outliers, the average for just the outliers, and the average for the values that fit into the report, minus the outliers. The three important factors about these types of distributions are: (1) the amount of times they occur; (2) the percent of the total values that are outliers; (3) the "in-range average."

If the percent of outliers is greater than 10%, the analyst should use the overall average, given in the first line of the report, for any comparisons. If the percentage of out-of-range values is less than 10%, the analyst can use the "in-range average" value for his comparisons since the effect of the outliers will most likely be minimal on the total system performance.

14.6.3 Memory Evaluation. The first step in a memory evaluation is to summarize all the pertinent information. The easiest way to do this is for the user to create a table similar to figure 14-4. The information for each column is collected from various MUM reports. Once the chart is filled out, the analyst can then ascertain a reasonable idea of the overall memory status of the system. The reports required to collect the statistics will be discussed, as well as an analysis procedure.

```
DISTRIBUTION COLLECTED ON SYSTEM NMCC AT 14:14:24 ON 81-05-15

      The Total Elapsed Time An Activity Was In Memory

                  Percent of Occurence

     Tenth    00   05   10   15   20   25   30   35   40   45   50
     Second    /    /    /    /    /    /    /    /    /    /    /

       0-1     Ixxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
       2-3     Ixxxxxxxxxxxxxxxxxxxxxxxxxxx
       4-5     Ixxxxxxxxxxxxxxxx
       6-7     Ixxxxxxxxxxx
       8-9     Ixxxxxx
      10-11    Ixxxx
      12-13    Ixxx
      14-15    Ixx
      16-17    Ix
      18-19    Ix
      20-21    I
        .
        .
        .
      56-57    I

      118669 Entries Total  Average 4.247  Variance 18.52  Standard Deviation 4.3
```

Figure 14-3. Sample Skewed Distribution

14.6.3.1 Obtaining the Data. The first step is for the user to examine the monitor data collection reports for the total time of the run. Any monitoring session of less than 2 hours in duration should be discarded. The Title Page will indicate the overhead generated by each of the GMF monitors active during the data collection phase. While this information is not used in this analysis, it is an item of information that is usually requested. Columns 1 and 2 of figure 14-4 can be obtained directly from the MUM Title Page. Under the System Configuration section of the Title Page, the amount of memory configured on the system will appear. This figure should be tentatively noted under column 5. Following this figure, the Title Page will list the amount of memory used by Hard Core, Core Allocator, SSA Cache and if any memory releases occurred during the monitoring session. All these functions have the effect of reducing the available user memory. These values should be summed and tentatively recorded under column 6.

Following the above information are several lines of statistics concerning the processing characteristics of the system. Columns 17 and 18 may be filled from this information. When determining the number of activities processed per hour, the analyst has two figures available. The analyst may choose to record the total number of activities processed per hour or he may record the number of (non-system schedular) activities processed per hour. During the course of the day many system schedular activities (activity 0 of any batch job) are processed. These activities are not really user generated, but rather are generated from the system. Therefore, by removing these activities from the total activities processed, a more realistic figure will be generated. The final three lines of the title page can be used to provide the data for columns 3 and 7 on the chart. Column 4 is filled from Report 1, columns 8 and 9 from Reports 11 and 12, columns 10 and 11 from Reports 16 and 17, column 12 from Report 19, column 13 from Report 51, column 14 from Report 37, column 15 from Report 50, and column 16 from Report 36. The two remaining columns that need to be completed are columns 5 and 6. The System Program Usage of Memory Report should be used to complete column 6. When processing the MUM data reduction program, the user should seriously consider using the MASTER input option. This will provide the user with a much better indication of the true system program load. In order to complete Column 6, the user should record the total value appearing under the "WEIGHTED TTM" column of the System Program Usage of Memory Report. This value should then be added to the value already recorded under Column 6. Finally Column 5 can be determined by subtracting the value reported in Column 6 from the value previously reported in Column 5.

14.6.3.2 Evaluating the Data. Figure 14-4 should be used in the following manner to determine if memory is a system constraint.

Step 1 - If Column 7 shows a surplus of memory greater than 15% of the total available memory or greater than two times the value reported in Column 4, the the implication is that there is no memory constraint on the system.

#1	#2	#3	#4	#5	#6	#7	
Date	Hours	CPU/IO Ratio	Avg Activity Size (K)	Amt of Memory available for User activities	Amt of Memory used by System Functions	Memory Surplus or Memory Shortfall	with and without the PALC Queues

#8	#9	#10	#11	#12
Avg Number of User Activities Waiting Memory	Avg Number of System Activities Waiting Memory	Avg Number of User Activities in Memory	Avg Number of System Activities in Memory	Ratio of Duration vs Memory Time

#13	#14	#15	#16	#17	#18
% Slave Memory Used	Amount of Time User Activity Swapped	Amount of Time Activity Waited for Original Memory Allocation	Number of User Swaps	Activities Per Hour (Throughput)	Total Swaps Per Hour

Figure 14-4. Memory Statistics

If Column 7 shows a surplus of memory, but does not exceed the aforementioned limits, the implication is that the current system has sufficient memory, but that the system is approaching memory saturation. If Colulmn 7 shows a shortfall of memory, and the value is greater than 15% of the total available memory or greater than two times the value reported in column 4, then the implication is that memory is a constraint on this system. Finally, if Column 7 shows a shortfall of memory, but does not exceed the aforementioned limits, the implication is that the system has reached memory saturation, but is still able to process the current workload.

Step 2 - It should be stressed that the value reported in column 7 is calculated over the entire measurement period and therefore could be biased by periods of heavy or light activity. It is for this reason that the user is urged to run the monitor during those periods of time where the workload is considered to be heavy and constant. In order to determine if the above type of biasing is occurring, the user may want to check Plot #1. If it appears that there is a mixing of light processing and heavy processing the user may want to re-run the data reduction program, using the time-frame option, to separate the heavy processing time.

Step 3 - Calculate the ratio of column 5 divided by column 4. This is an indication of the maximum number of user jobs that your system can support at any one time, without the occurrence of significant swapping. If the value in column 10 is equal to or exceeds this ratio, then the implication is that the system has reached memory saturation. If the value in Column 10 is within 2 units of the ratio, then the system probably has sufficient memory but is approaching saturation. Finally, if the value in column 10 is less than the ratio by more than 2 units, the current system has sufficient memory.

Step 4 - If column 13 is less than 85, the current system should have sufficient memory and the other steps should not be showing indications of memory problems. If column 13 is between 85 and 95 then the current system is approaching saturation and at times may be showing some indications of a backlog. If the figure exceeds 95, then other steps should be indicating signs of moderate to severe memory problems.

Step 5 - If column 8 is greater than or equal to 3, the indication is that memory has become a constraining factor.

Step 6 - If Column 12 is greater than 2, the indication is that memory wait time is high and that memory is probably a constraining factor.

At this point, the user should have a fairly good indication as to whether or not memory is a constraining factor. The following steps will indicate some additional reports that the user should reference to determine those jobs that might be causing the memory problem.

Step 7 - One of the largest users of resources are jobs that abort and then must be rerun. Aborts usually occur due to user errors, but hardware aborts are not uncommon. If management is aware of aborting jobs and the reasons for them, they can possibly save substantial system resources. The Abort Report is described in Chapter 6 and gives an indication of the system resources being wasted by aborting jobs.

Step 8 - It is important for management to be aware of jobs that are either misusing system resources or are requesting large amounts of system resources. Upon identifying such jobs, these jobs could be redesigned, scheduled for non-peak processing, or, in the case of wasted resources, the waste could be eliminated. The Excessive Resource Report allows the user to uncover jobs of this type and is described in Chapter 6. When using this report, the following are suggested parameter values:

wasted core - 5K
memory - either 35K (WWMCCS standard) or 2 times the value in column 4
CPU time - 15 minutes
IO time - 30 minutes

Step 9 - By examining the System Program Usage of Memory Report, the user can determine those system type jobs that are requiring memory. It is possible that some of the system jobs can be eliminated or at least reduced in size. This is especially true for the Time Sharing Subsystem. However, it must be realized that a limitation on Time Sharing size may adversely effect Time Sharing response. In many cases, if large file transfers are being processed during prime time, the size of the FTS WIN subsystem can rise to 70 or 80K. By not allowing WIN file transfers to run during prime time, significant memory savings can result.

Step 10 - Memory problems may also be occurring as a result of jobs being delayed due to CPU constraints or I/O constraints. In these cases, jobs tend to sit in memory due to a lack of other system resources. Because these jobs are being delayed, other jobs cannot enter memory, and memory demands begin to backlog. Therefore, if memory is a constraint, the user should consider conducting a CPU analysis as well as an I/O analysis.

14.6.4 CPU Evaluation. The CPU evaluation will determine the general utilization level of the processor and then determine if the CPU is dominated by GCOS or user program execution. A CPU data reduction is required for this evaluation. It is also beneficial to have an associated MUM data reduction available for the same time period. Figures 14-5 and 14-6 are sample table formats that may be used to display the gathered data.

14.6.4.1 Data Recording. For Figure 14-5, data for columns 1 and 14 can be obtained from the heading page. Data for columns 2-8 can be obtained from the last section of the CPU Time Report. This report is produced every 10 minutes of elapsed time and the data of interest should be found in the last 10-minute report. Columns 9-13 are filled from Histogram Reports 1, 2, 5, 6, 9 respectively. For figure 14-6, the data may be obtained directly from the last line of the CPU Plot.

14.6.4.2 Evaluating the Data.

Step 1 - The CPU may by considered a bottleneck if column 7 of figure 14-5 is less than 20 or Column 2 of figure 14-6 is greater than 50. It is a fairly agreed upon standard that average processor utilization should not exceed 80%. By maintaining average processor utilization at this level, the processor will have sufficient remaining capacity to be able to handle those peaks of processor demand that normally occur during the day. The three category breakdowns of figure 14-6 represent the three conditions of insufficient power, sufficient power, and excess power respectively.

Step 2 - If column #6 of figure 14-5 is greater than (100-column 7 of figure 14-5)/2, then the CPU is dominated by user activities. Otherwise it is dominated by system-oriented functions.

Step 3 - Column 8 of figure 14-5 provides an indication of the percentage of CPU power being lost because multiple processors are interfering with each other. Within GCOS, there are many tables that must be updated and/or referenced by a processor during its execution. When these tables are being used, the processor must insure that they are not altered in any manner. In order to accomplish this, the processor will lock a gate. This locked gate will prevent any other processor from accessing this table. When the first processor has completed its use of the table, the gate will be opened. If a processor must access a gated table, it will simply perform a "CPU loop" at that table, waiting for it to be opened. The amount of time being spent in this gate locked-CPU loop code is depicted under column 8.

Step 4 - If step 2 indicates that user jobs are the predominant users of the CPU, then the MUM Excessive Resource Report can be used to determine those jobs requiring excessive CPU resources. In addition, the CPU Plot report can be used to determine those times of day when processor availability is in the critical range. Using these two items of information, system schedular classes can be created based on CPU requirements.

Step 5 - Another indication that the CPU is a bottleneck can be determined from columns 9 and 10 of figure 14-5. If the sum of these two columns exceeds Column 14 by one, then jobs are being queued for the CPU. This queuing of jobs at the CPU is an indication that during some period of the day, there is insufficient CPU power to handle the workload. Once again, the CPU Plot can be used to determine those periods of time.

Step 6 - Columns 11 and 12 can provide an indication that there is an I/O backlog in the system. If the sum of these two columns is close to the overall multiprogramming depth of the system (determined from the MUM Reports) then the indication is that there is an I/O backlog, and an I/O analysis should be conducted.

#1	#2	#3	#4	#5
Date-Time	System Utilization	TSS Utilization	TPE Utilization	WIN Utilization

#6	#7	#8	#9
User Utilization	Idle Processor	Gate Loop	# of System Activities in CPU Queue

#10	#11
# of User Activities in CPU Queue	# of System Activities in Memory with Outstanding I/O

#12	#13
# of User Activities in Memory with Outstanding I/O	Number of Nonactive Activities in Memory

#14
Number of Processors Configured

Figure 14-5. CPU Program Characteristics

#1	#2	#3	#4
Date-Time	% Less Than 25	% Between 25-50	% Greater Than 50

Figure 14-6. CPU Processor Availability

14.6.5 I/O Evaluation. The I/O evaluation will determine whether the mass storage subsystem, or tape channel subsystem is the cause of system degradation. This evaluation requires the user to have processed the Mass Storage Monitor and Channel Monitor data reduction programs.

14.6.5.1 Data Recording. All output from the Mass Store Monitor and Channel Monitor are required. No individual work tables are required, but the user may generate some if he feels that it will help in his analysis.

14.6.5.2 Evaluating the Data. Chapters 7 and 8 provide a fairly detailed description of the procedure to be followed in analyzing the associated reports. In this section, reference will be made to those chapters indicating actual data values that should be used as a reference for comparison.

Step 1 - Analyze the Channel Monitor Idle Report. This report can be generated only if the Idle Monitor was run in conjunction with the Channel Monitor. If the "% of Idle Time During Which I/O Was Active" value exceeds 25%, then substantial benefit may be obtained by eliminating I/O contention. The above value is an indication that even though the CPU is going idle (i.e., has no useful work to perform) there really is potential CPU work available. However, under current conditions, this potential CPU work is being delayed because of I/O contention.

Even though the above figure exceeds 25%, the system may not have sufficient CPU power available to handle the increased work generated by removing the I/O contention. Therefore, the analyst should also check that the "Average System % Idle" figure exceeds 15%. If this proves to be the case, then removal of any I/O contention should prove beneficial. On the other hand, if the figure is lower than 15%, then removal of any I/O contention will probably result in additional CPU contention. The Idle Report will also indicate those devices causing most of the contention. Make a record of the device numbers.

Step 2 - Examine I/O queue length and I/O queue time histograms for individual devices and channels. Queues greater than one and queue times greater than 15 MS should be considered significant. Record those devices with high contention.

Step 3 - If certain devices have been determined as bottlenecks under the procedures described in Steps 1 and 2, the Job Conflict Report should be obtained for those devices following the procedures described in Chapter 8.

Step 4 - Execute the Mass Store Monitor Data Reduction Program. Following the procedure described in Chapter 7 for monitoring a specific device, the analyst should be able to determine the exact files that are causing the contention found under the earlier steps.

Step 5 - Chapter 7, section 7.3, provides a detailed description of the output from the Mass Store Monitor and sufficient information for interpreting all MSM reports. When investigating seek elongation problems, an average seek of over 45 cylinders should be considered significant.

Step 6 - This step outlines procedures for relocating files identified as candidates for file relocation. Because of automatic load-leveling activity by the GCOS operating system, an analyst has only limited flexibility for the placement of system, permanent, and temporary files:

a. System Files. The device name on which a system file is to be placed can be specified at system startup. Care should be taken to insure that multiple high-used system files are not placed on the same disk device. If possible, separate high-use system files across disk subsystems. In addition, ensure that SSA Cache memory and FMS cache are enabled to reduce disk I/O activity to certain system files.

b. Permanent Files. The device name for a permanent file can be specified at creation, whether through FMS or the ACCESS subsystem of Time Sharing. Files can be moved by changing their names, creating a new file with the old name, and moving the data. The new file can be created with a DEVICE specification.

c. Temporary Files. The device name for a temporary file can be specified in the second field of the $FILE card in the job control deck. Jobs which run frequently can have their $FILE cards changed. Other jobs can be controlled by policies governing the use of $FILE cards.

Additionally, sites that have different device types may specify preferred device types to be used for temporary files. This procedure will allow activities requiring disk storage to take advantage of higher speed devices.

Step 7 - This step identifies possible seek contention problems attributable to inadequate temporary file space. This procedure uses the SPUTIL feature of the GCOS FMS facility and the Disk Fragmentation Report available at most sites. If such a report is not available, contact CCTC/C751. It is necessary to analyze temporary disk capacity on all disk units rather than just the units identified in previous tuning steps. This analysis is necessary because the disk units exhibiting high activity due to temporary file use often have more available temporary space. The increased utilization of these disk units may be caused by inadequate temporary storage on other disk devices. For this analysis a form as shown in figure 14-7 may prove useful.

a. Report Values. The SPUTIL Report contains the following information on each disk device: (1) device identification, (2) overall capacity, (3) available disk space, (4) disk space dedicated to permanent storage. The Disk Fragmentation Report contains additional information on each disk device: (1) number of disk fragments, (2) average fragment size, (3) maximum fragment size, (4) percentage distribution of fragments by size, and (5) total fragmented space.

b. Form Entry. Enter the device identification for each disk device on the Temporary Storage Test Form. For each disk device enter: (1) the LLINK capacity as indicated by the SPUTIL Report in the Total Capacity column; (2) the temporary capacity from the SPUTIL Report in the Temp Capacity column; (3) the number of fragments from the Disk Fragmentation

DEVICE	TOTAL CAPACITY	TEMP CAPACITY	RATIO 1	RATIO 2	NUMBER OF FRAGMENTS	MAX SIZE	PERCENT FRAGMENTS 1-12	PERCENT FRAGMENTS 13-121	TOTAL PERCENT	FRAGMENT

Figure 14-7. Temporary Storage Test Form

Report in the Number of Fragments column; (4) the maximum fragment size in the Max Size column; (5) the percentage of fragments (1-12 and 13-121, respectively) in the Percent Fragments column.

c. Calculations. Divide the temporary capacity of each disk device by the total capacity, and place the result in the "Ratio 1" column. Add the Percent Fragments 1-12 and the Percent Fragments 13-121 columns and place the sum in the Total Percent column.

d. Decision. Place a check mark in the "Ratio 2" column if the ratio of temporary storage to total storage is (.15). Place a check mark in the "Fragment " column if (1) the number of fragments is 100, (2) the maximum size of a fragment is 2000, and (3) the total percentage of fragments less than 121 LLINKS (10 LINKS or less) is 40.

Step 8 - If devices have been checked in Step 6, then the temporary file space on these devices is constrained by either (1) insufficient file space ("Ratio ") or (2) disk fragmentation ("Fragment ").

If a large number of devices need to be checked, then overall temporary disk space availability may be a constraint to system performance. At this point a site should either institute procedures to recover permanent disk space (purging of unused files) or re-evaluate disk capacity relative to system workload.

If certain disk devices have been checked because of their temporary to total ratio, or if many devices have been checked because of disk fragmentation, then the following procedures to balance the file system should be instituted.

a. Fragmentation. Temporary disk space may be compacted by a full restore of the file system (cold boot). The Disk Fragmentation Report, run daily, could help determine the frequency at which a full file system restore would be necessary.

b. Amount of Available Space. The full file system restore redistributes permanent files to equalize the amount of temporary storage on each pack. The FMS SPUTILST Report should be examined after the restore to verify that disk units have been balanced. Temporary disk space may still not be evenly distributed if (1) users have specified specific devices for permanent files or (2) unusually large files are present on certain disk units. Consider such factors as intentional file placement for maximum seek activity and operational requirements of data bases before moving permanent files.

14.6.5.3 Mass Storage Operation. The following article appeared in the September 1981 WWMCCS H6000 World Magazine. It presents an excellent description of disk operation and some problem areas that a system analyst should be aware of.

"We won't discuss the gyrations that GCOS performs in setting up an I/O request; e.g., management of PAT pointers, PAT bodies, etc. (We recommend the HIS GCOS Analysis course). Our interest begins at the point when an I/O request generated by some workload element is presented to the I/O Supervisor (IOS) for service. We don't care whether the I/O came via GFRC or directly from a MME GEINOS. We do care about the major logical/physical events from this point to I/O termination which are important to understanding system performance.

"As an example, let's assume that we have a dual-channel micro-programmable controller (MPC) cross-barred to its disk devices. Dual-channel means that the MPC has two physical data paths for transferring data to the IOM. Cross-barred to the device means that there are two physical paths from the MPC to each of its devices.

"Let's also assume that the IOM is cross-barred at two-to-one. IOM cross-barring refers to the logical-physical hardware channel relationship of the IOM. This relationship is defined to GCOS in the STARTUP deck and maintained in the Secondary Configuration Table and elsewhere. For the example, assume that PUB addresses 0-8 and 0-9 are associated with one physical MPC channel, and that 0-10 and 0-11 are associated with the second MPC channel as is shown below:

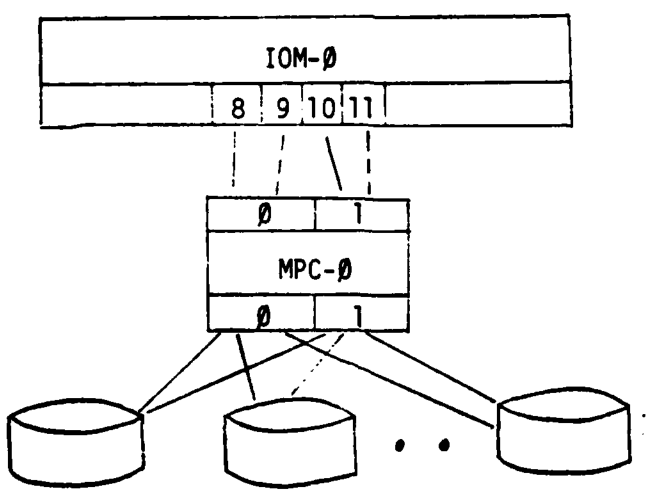


Figure 1

"Defined in the STARTUP deck is the primary PUB address for the disk subsystem and the order in which logical paths will be assigned by GCOS during processing. The card

```
        $       IOM-0           PUB-8,MS0450,UNITS-6,
        $       ETC             UNIT-1,ST1
                  :
```

defines PUB 0-8 as the primary PUB address for a MSS451 subsystem. The card

```
        $       XBAR            IOM-0,PUB-8,PUB-10,PUB-9,PUB-11
```

defines the order in which PUB assignments will be made. This information is maintained by GCOS in the I/O stream table. All requests for a device are made with its primary PUB address, e.g., an I/O request for device 6 on this subsystem would request IOM-PUB-DEVICE = 0-8-6.

"Suppose that IOS receives a request for I/O to 0-8-6. If the device is currently performing an I/O (i.e., busy), the I/O request is queued for later service. If the device is free, IOS will assign a logical channel to the request if one is available. It will attempt to assign PUB 0-8. If 0-8 is busy, it will attempt to assign 0-10, etc., in the order prescribed on the $ XBAR card. If no logical channel is available, the I/O request will be queued for later service as before.

"To recap, for an I/O request to become active (in-service), both the requested device and a logical channel associated with the MPC which controls the device must be free. Otherwise the request is placed in the I/O queue. Normally the request will be placed at the end of the queue; i.e., behind earlier I/O requests. However, certain I/O requests are linked in front of the queue, e.g., TSS requests for access to its swap files (#S, #T, #U, #V). This can impact system performance and will be discussed later.

"Whether or not our request for I/O to 0-8-6 becomes active, IOS will scan the I/O queue to determine if any earlier I/O requests can now be activated (device and logical channel free). When an I/O request can be activated, IOS loads the mailbox in Hard Core Memory for the logical channel and signals the IOM. This mailbox contains information required by the IOM to process the I/O independently of the mainframe processor. The IOM loads the mailbox information into its scratch pad memory and begins processing the physical I/O.

"Thus far, the events which have occurred were independent of the type of disk device involved. The three phases of physical delay for a disk device are seek time, rotational latency, and data transfer. The IOM issues a seek request to the MPC for 0-8-6, but now performance implications arise which depend both on the physical characteristics of the device, and on device-dependent interactions with IOS which might be required.

"First let's look at seek time, defined as the time required to move the read/write heads from their current position to the cylinder requested by the current I/O. For a given device, seek time is proportional to the number of

cylinders traversed. Table 1 gives seek times for H6000 disk devices. The table provides sufficient information to derive the average seek time for a device from the average number of cylinders moved (available from MSM).

Device	DSS181	DSS191	MSU450
Minimum	10 ms	10 ms	8 ms
Average	34 ms	30 ms	25 ms
Maximum	60 ms	55 ms	55 ms
Cylinders/pack	200	404	808

Seek Specifications
Table 1

"Now that "seek" has been defined, we can discuss the motivation of implementing the logical-physical channel architecture. The disk subsystem can have as many seeks and data transfers ongoing as there are logical channels assigned to the subsystem. The number of simultaneous data transfers that can be performed is limited by the number of physical channels. In our example, we could see two devices connected to the physical channels transferring data and two additional devices moving the read/write heads to the requested cylinder (seeking). Or, we could have one data transfer ongoing with three seeks, or we could have four seeks ongoing, etc. So the purpose of IOM cross-barring is to increase the simultaneity or overlapping of device seeks.

"When the seek to the requested cylinder has been completed, the device is ready to transmit or receive data. Here again a device-dependent performance consideration comes into play. For a DSS191 or MSU450 disk subsystem, once IOS has loaded the channel mailboxes and signalled the IOM, it performs no further service to the I/O request until an I/O termination interrupt is received for that device. The determination of seek completion and assignment of the physical channel for the data transfer takes place completely in the MPC. Not so for the DSS181 subsystem.

"The DSS181 does not provide a seek complete interrupt, and so IOS must check for a seek complete status each time it gets control for an I/O request as described above or for servicing an I/O termination interrupt. This introduces another delay for the 181s from the time seek completes until the next time IOS is activated. When IOS detects seek complete for a 181, it must issue another command to connect the physical channel and begin data transfer.

"If both of our physical channels are busy transferring data, there is another delay until a physical channel is free. But let's suppose the seek has completed, a physical channel is available for connecting to the device (whether by the MPC or by IOS) and we are ready to transfer data. Another delay is imposed now due to the rotational latency of the device. This is the time from physical channel assignment until the requested sector rotates to the read/write heads. This delay is a function of the rotational velocity of

the device. The minimum latency for a device is always 0. (The data is at the heads at channel connect time.) Maximum latency for a device is the time required for 1 revolution of the disk, and average latency is generally defined as the time required for 1/2 revolution (see Table 2).

Device	DSU181	DSU191	MSU451
Rotational Speed	2400 RPM 40 RPS	3600 RPM 60 RPS	3600 RPM 60 RPS
Avg. Latency	12.5 ms	8.3 ms	8.3 ms
Max. Latency	25 ms	16.7 ms	16.7 ms

Rotational Latency
Table 2

"A word about Rotational Positional Sensing (RPS). RPS is a feature available on some disk subsystems -- a required option (?) on MSU451s -- which keeps the MPC informed about the rotational position of each disk. In a situation where the physical channel is free and more than one device has completed it's seek, the MPC can assign the physical channel to the unit whose requested sector is closest to the heads. The idea is to reduce rotational latency thereby increasing the physical channel time which can be utilized for data transfer. What does RPS buy you if only one disk unit has completed its seek when the physical channel is assigned? Not a thing.

"Now that device 0-8-6 has been assigned the physical channel and the requested sector is under the heads, the physical transfer of data begins. The time to complete the transfer of data depends on the number of words to be transferred, the rotational velocity of the device, and the recording density of the media. Data transfer rates per second are given in Table 3.

Device	DSU181	DSU191	MSU451
Transfer	416KC	1074KC	1074KC
Rate	69.33KW	179KW	179KW

KC = 1000 - 6 BIT CHARACTERS
KW = 1000 - 35 BIT WORDS

Data Transfer Rates
Table 3

"When data transfer has completed, an I/O terminate interrupt is issued to the H6000 CPU (CPU 0). The GCOS dispatcher suspends execution of the program in operation, performs a few housekeeping duties and then dispatches CPU 0 to the disk channel module in IOS. A bit more housekeeping and, for our purposes, the I/O to 0-8-6 is complete. IOS then checks the I/O queue for seeks to start -- note that at this point it has a free logical channel, and so can start at least one seek if an I/O request is pending against a free device on this subsystem. If a DSS181 subsystem is present, it must also check for a seek complete status as described above. When IOS can perform no more actions, it relinquishes control to the dispatcher.

"In terms of capacity, a DSU1191 can hold as much data as approximately 4.3 DSU181 packs (see Table 4). A MSU451 can store roughly 2 DSU191 packs or 8.6 DSU181 packs worth of data. In terms of data transfer rates, the 191s and 451s are about 2.6 times faster than 181s.

Device	DSU181	DSU191	MSU451
Char. per pack	27.6mc	117.9mc	235.8mc

Device Capacities
Table 4

Here are a few WATCHITs.

"WATCHIT 1: When replacing 181s with 451s. The vast capacity of the 451s make it feasible to replace up to 8 181s with a single 451. In a situation where 4 I/Os were pending to files residing on 4 different 181s (our 2 to 1 cross-
barred dual channel example), as opposed to the 451, the 181 configuration might be preferable. Although the 451 is 2.6 times as fast, we would sacrifice overlapping of the seeks, and the 181 subsystem can transfer data from 2 of the devices in parallel. The CM Device I/O Queue Length Histrogram and the Channel Free-Device Busy Report can indicate if a device contention problem exists.

"WATCHIT 2: When pondering vendor specs for 181s. We modified the MSM data reduction program to obtain the average data transfer size to each disk device. MSM also provides the average cylinders seeked per I/O for each device. Assuming the average rotational latency, one should be able to use the vendor specs provided in this article to compute the I/O service time for a given device. The I/O service time for each device is provided as a CM report. For MSU451s the computed value matches the CM report to within a few milliseconds. However the 181 computed and monitored values differ by as much as 30ms and more -- the computed value always being less. Since channel utilization is fairly low, the most likely reason for this discrepancy is that IOS latency time we discussed earlier.

"WATCHIT 3: When placing TSS swap files (#S, #T, #U, #V). We mentioned earlier that TSS requests for access to it's swap files were linked to the front of the I/O queue. TSS is not one to wait on user I/Os, nor does it break it's swap action into nice little 320-word standard system format I/Os.

It's gonna swap the whole thing. Say, there's a nice little TSS COBOL subsystem -- only 40K! Time to swap? So soon? Oh yeah, that memory-time quantum. Lot of memory -- not much time. Oh well, a 40K transfer is OK. My swap files are on fast 451s. Friend, you just tied up that device for almost a quarter of a second, and more importantly, a physical channel as well. That's only half of it. TSS swapped it out, you can bet it'll swap it back in. So we're up to .5 sec of physical channel time to free up some TSS user memory. This scenario impacts total system throughput, not just TSS. That's not all the havoc that larger user subsystems create, but that is enough heartburn for now."

This page intentionally left blank

DISTRIBUTION

Addressee	
CCTC Codes	
C124 (Reference and Record Set)	3
C124 (Stock)	6
C751	30
C430	230
DCA Code 312	1
Defense Technical Information Center, Cameron Station, Alexandria, Virginia 22314	12
	282

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CSM UM 246-82	2. GOVT ACCESSION NO. AD-A116898	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Generalized Monitoring Facility Users Manual 1 May 1982		5. TYPE OF REPORT & PERIOD COVERED 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Barry Wallack George Gero		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Computer Performance Evaluation Branch Defense Communications Agency/CCTC/C751 Pentagon, Washington, D.C. 20301		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Computer Performance Evaluation
11. CONTROLLING OFFICE NAME AND ADDRESS Same as above		12. REPORT DATE 13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for Public Release -- Distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Honeywell, Performance Evaluation, Software Monitor, Resource Monitor, Tuning

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This Users Manual provides the information necessary for an individual to run all of the programs that are comprised in the Generalized Monitoring Facility. Program interrelationships are presented, as well as a general overview of the processing, input, and output procedures for each program. The Generalized Monitoring Facility is a sophisticated software monitor for the Honeywell 6000 computer systems.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)


ILMED
8